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FOREST RESEARCH  
BI-MONTHLY REPORT

October 1, 1941

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## GENERAL

### Allegheny

Personnel. Ostrom and Little have returned to the Yale School of Forestry for studies leading to the doctorate in forest management. Ostrom has selected a study of hemlock reproduction for his dissertation, and Little will study the factors affecting the reproduction of Atlantic white-cedar. Mitchell was selected to head up the study of vegetative propagation of slash pine for the Southern Station, and Mollenhauer was recalled from BAE to finish the Connecticut Flood Control Report.

### Appalachian

Personnel. In September Jemison was detailed for two weeks to the Chemical Warfare Service Training School at Edgewood Arsenal, in Maryland, to receive training in organization of civil defense against war gases, and incendiary and high explosive bombs. Four Forest Service men were sent to this school, and it is believed that recommendations will be forthcoming on the part the Forest Service can play in civil defense.

J. H. Buell is at Duke University working for his Ph.D. degree.

### California

The Products Division sustained the temporary loss of its chief, L. N. Ericksen, when he was assigned to the Washington Office for the duration of the defense emergency.

### Central States

Ohio Forest Survey Growth Conference. A meeting was held September 3 to 6, 1941, at the Central States Forest Experiment Station, Columbus, Ohio, to discuss growth determination in connection with forest resource inventories such as the Nation-wide Forest Survey and the Ohio Farm Woodland Survey.

The primary purpose was to give fresh consideration to the question of growth for large areas and especially for woodland conditions such as obtain in Ohio and other states in the Central region and to prepare a memorandum incorporating the results of the meeting which would be a guide to the Nation-wide Survey when it reaches the region and to the Ohio Survey now in progress. Representatives particularly interested or qualified to discuss growth were invited to attend from the Central States, Lake States, and Appalachian Stations, the Ohio State Forester's Office and the Washington Office.

Three days were used for discussion, presentation of Forest Survey growth procedure and experience by Gevorkiantz and Evans for the Lake

(Over)

## GENERAL (cont'd.)

States and Appalachian regions, description of Ohio Survey by Diller, explanation of the place of growth in the Nation-wide Survey by Garver, and the preparation of this memorandum by a special committee set up the first day. One day was spent in the field studying the different classes of woodlands recognized by the Ohio Survey as background for a decision on the most appropriate growth procedure.

Through group discussion it was decided that the "Growth Table" method of the Lake States or the "Growth Factor" procedure of the Appalachian and Southern Stations would be the most appropriate of the several ways of determining growth for large areas for the Central States. Of these the latter seemed most feasible for the Ohio Survey in view of its technical and financial limitations and because a growth procedure was not developed at the time the inventory field instructions were prepared. The Lake States "Growth Table" method was by no means ruled out but instead retained as an alternative plan to be given full consideration because of its potentialities in future work in the region. To facilitate this and to provide a reference memorandum for the Forest Survey and the Ohio Survey it was decided to ask Gevorkiantz to prepare a fairly detailed description of the application of the method to Central States conditions.

The last two days were devoted to crystallizing a procedure to apply to these stands. Northeastern Ohio was selected as the initial unit for collection of growth data and testing of the possibility of treating growth from a county basis rather than from the larger unit basis.

Defense Survey. In cooperation with the office of Region 9 and the Forest Products Laboratory, initial meetings have been held looking toward a survey of primary and secondary wood-using industries in the Central States Region. On August 5-8, H. B. Wales conferred with the Station at Columbus and on August 21-22 Wales and Kellogg contacted C. V. Sweet at the Forest Products Laboratory in Madison, Wisconsin.

## Northern Rocky Mountain

Rapraeger Resigns. E. F. Rapraeger, who has been with the Division of Forest Products for 5 years and in charge of the division for the past  $1\frac{1}{2}$  years, has resigned to go into private employment as research forester for Potlatch Forests, Inc. Rapraeger went on annual leave September 15, and his resignation is effective October 16.

We are sorry to lose Short by transfer to the Soil Conservation Service, which is to take place soon. Paul Lemon left late in September for graduate work at the University of Minnesota, and Anthony B. Evanko will soon register at the University of Montana for undergraduate studies.

## GENERAL (cont'd.)

### Pacific Northwest

The Division suffered a distinct loss September 1 when the CCC position of technical supervisor and inspector of stand improvement work, which Theodore Kachin had occupied for three years, was discontinued. He has done valuable work in developing improved technique for the conduct of CCC stand improvement activities on the national forests and contributed much to this phase of our technical knowledge.

The Forest Management staff was diminished 25 percent during the summer months by the loan of Donald Matthews to the Regional Forester to help on the newly launched CFFC program. Hence, Fire Studies has been on a slow bell during this period.

### Rocky Mountain

Personnel. J. T. Cassady and H. D. Burke were called to active duty as reserve officers about July 1. Cassady's work is now being handled by Clyde Doran under duration-of-work appointment. Burke's work in flood control surveys was closed when he left the station.

### Southwestern

Removal of the Station headquarters from rented quarters in the city of Tucson to its new location on Tumamoc Hill was completed in June 1941. The new site was formerly the Desert Laboratory of the Carnegie Institution of Washington and was transferred, by deed of donation, to the United States Government in 1940 and the donation accepted by the Secretary of Agriculture as the headquarters for the Southwestern Station.

The large main laboratory building, 20 by 122 feet, and the single former Carnegie 6-room office building, 28 by 46 feet, have been completely renovated, and, in addition, a new 6-room office building, 34 by 42 feet, constructed in part with WPA funds. One section of what will eventually be a 12-stall garage and equipment shed was also completed.

The fences surrounding the entire 885-acre tract (245 acres now Federal land and 640 acres of State land under lease) have been brought to standard repair, in accordance with the gentlemen's agreement with the Carnegie Institution that the area would continue closed to grazing and all other forms of vegetation disturbance.

Personnel. C. K. Cooperrider, Chief of the Division of Forest Influences, was selected as the Forest Service representative on the Southwestern-Intermountain Committee directed to be created by the Secretary of Agriculture to investigate, report and make recommendations on all aspects of irrigated and dry farming agriculture in the Intermountain and Southwestern territories.

## FOREST ECONOMICS

### ECONOMIC - SOCIAL BENEFITS

#### Allegheny

The defense boom has unquestionably reduced unemployment in the anthracite region in recent months. One responsible official has even gone so far as to tell us that no man whole of mind and body need go without a job today. In the anthracite mines, however, which are the chief employers of labor, there are jobs and jobs. Much mining is done under contract. We have good reason to believe that some of the so-called jobs now open are in such inaccessible or difficult locations that a decent day's wage cannot be earned by those undertaking them. The fact that men still prefer to risk their lives in ill-timbered, ill-ventilated "bootleg" mines, where fatalities are four times as frequent as in the legitimate mines is evidence that unemployment is still a serious problem. The Anthracite Emergency Committee, made up of officials of the United Mine Workers of America as well as operators, reported to the Governor of Pennsylvania as late as mid-April of this year that their investigators had found 2,905 "bootleg" coal holes, operated by 12,098 men and turning out 5,000,000 tons of coal a year. A rise of 5% in the output of anthracite coal over the same period last year has absorbed some of the free-lance miners into the legitimate industry, but it must be remembered that the output of coal per man-day in 1941 is at least 50% higher than it was 15 years ago. Defense jobs have been taken by many workers from the anthracite territory in neighboring states, such as New York and Connecticut. So far few of these men are said to have moved their families to the new jobs, and the majority will return to the anthracite region as soon as the defense industries slacken their activities.

Evidence that forest land today contributes little to the economic life of the region is the fact that the forest lands of five of the anthracite forest counties today make up less than 1% of the total real property valuation, although comprising 20 to 68% of the land area. In no county does forest land comprise more than 11% of the total real property valuation, while the percentage of forest runs as high as 84. These facts are brought out in publication No. 3 of the Survey: "Tax Delinquency of Forest Land in the Anthracite Forest Region of Pennsylvania." The sub-title of this paper is "A county opportunity and responsibility", because in Pennsylvania tax delinquent lands revert to the counties, and under a law enacted in 1933 may be converted by the counties into county forests. We found a total of 120,000 acres of tax delinquent forest lands, over 50 acres in size, in the 15 counties, more than half of which was beyond the period of redemption allowed the original owners. Although the main purpose of this paper was to show that there are substantial areas of forest in public hands, the permanent improvement of which for public purposes might absorb much emergency labor, we spent a little time

## ECONOMIC - SOCIAL BENEFITS (cont'd.)

in the study of assessed values and annual taxes as possible contributors to tax delinquency. The annual tax per acre on forest lands average as low as \$.07 an acre in one county, and do not exceed \$.21 an acre in any county; the corresponding assessed values per acre are \$5.27 and \$6.65. The average assessment in one county, with a \$.10 tax, is only \$2.87. We were necessarily cautious in drawing any conclusions from these average figures, but on the basis of them and of more detailed knowledge, not published, we frankly doubt whether heavy taxation is a serious bar to the practice of private forestry in much of the anthracite region.

An invitation to present our findings before the Fifty-fifth Annual Meeting of the Association of County Commissioners of Pennsylvania resulted from our Paper No. 3. Pennsylvania has fostered fairly strong county governments that cannot be ignored in planning a better forest economy.

In spite of what has just been said, we doubt if reports for a single county are either necessary or effective; Luzerne County, the largest in the anthracite region, is being used as a guinea pig in this connection. Our W.P.A. field crews completed their job in Luzerne County last winter. They found that 68.4% of the county's 570,000 acres are in some kind of forest; and that there were in 1940 34,000 acres of saw timber and 85,000 acres of merchantable cordwood. About 38,000 acres are in scrub oak or similar species, and 15,000 acres in recent reproduction. The great bulk of the forests, or 218,000 acres, are in unmerchantable cordwood - stands of commercial species, but with a volume per acre of less than 5 cords.

Although drain and growth figures have not been thoroughly analyzed as yet, we already know that the drain on the 6% of the county which is in merchantable saw timber is much in excess of growth, and that in the first half of 1941 the cut by some 55 local sawmills was as great as in all of 1940. In addition to figuring standing timber, drain, and growth in board feet and cubic feet, we have found it necessary for local use to calculate them in tons of wood. Many mine props in the region are bought by the ton, and we have been obliged to tackle the problem of converting cubic feet and board feet to tons. Because most of the mine props are oak, and because they are generally delivered to the mines within three days of cutting, the average weight appears to be above 60 lbs. per cubic foot. Madison Laboratory figures on the relative weights of the several species in clear pieces have been found to hold pretty well for green, knotty wood, with bark.

The W.P.A. forest inventory crew is making good progress. The field work in Lackawanna County has been completed, and Wyoming County has been about half covered. An extremely promising recent development of the inventory is the intensive use of air photographs in the preparation of maps, not only of forest areas, but also of forest conditions. A forest condition map, distinguishing between saw timber, cordwood, reproduction, and scrub oak for Wyoming County, about 250,000 acres in

## ECONOMIC - SOCIAL BENEFITS (cont'd.)

total area, was made from the photographs on a previously prepared base in about two weeks. Planimetering (actually gridding) the forest condition map of Luzerne County, earlier made, revealed a sizeable discrepancy between the area mapped as saw timber, and the same area determined by the ground crews' sampling.

With the help of Osborne, from Forest Management, we are making a careful analysis to determine whether we can accept the evidence of the air photos as to forest condition; and if not, what type and degree of ground sampling will give us more accurate figures. Osborne feels that we have probably a unique body of evidence from which to evolve inventory methods which will give us a specified degree of accuracy.

Two sets of gross board foot volume tables - one, local tables based on site, the other, based on Girard form-class - were early prepared for inventory use by Girard and Mesavage. Checked by Mesavage against volumes of felled trees in several widely-distributed local cuttings, and against volume tables in use by the Forest Service in New York, the southern Appalachians, and the Lake States, the form-class taper tables promise to be a very valuable by-product of the inventory. They are now in use on the Kane Experimental Forest. Their main value, however, we believe lies in their demonstration that species has very little influence on the merchantable volume of hardwoods, of any given diameter and number of logs, which have the same taper in the first log. In other words, a single set of these basic tables may well prove quite sufficient for the construction of local tables of merchantable board foot volume for any hardwood in the eastern United States.

### Lake States

Timber Marketing. As a follow-up to the preliminary work done last spring toward starting a cooperative for small operators on the Chippewa National Forest, Dickerman has been assembling the data necessary for the preparation of an analysis of the financial requirements and marketing difficulties encountered by the small woods operators on the Chippewa National Forest in Minnesota. A preliminary analysis of these data indicates that about 80 percent of the volume and 72 percent of the value of the material marketed from the Chippewa National Forest is cut by small operators. The average value of the stumpage purchased by these operators is slightly over \$300. Two-thirds of these operators have been logging national forest timber for three years or less and due to their inexperience have many problems confronting them. Foremost of these is the difficulty of financing their products from the stump to the buyer. In order, therefore, to assist such operators to get around this obstacle, an informal cooperative association has been formed and a loan application presented to the Farm Security Administration. It is anticipated that this money will be available shortly and as the operating procedure is worked out the organization will serve as the nucleus for a formal cooperative association.

## ECONOMIC - SOCIAL BENEFITS (cont'd.)

In southern Minnesota C. H. White, in cooperation with the Soil Conservation Department and the County Agent, has been laying the groundwork for the organization of a cooperative among the farmers of Winona County to enable them to dispose more profitably of their woodlot products. A modern plant is contemplated which will include not only a sawmill but also a planing mill.

At a short course held by the University of Minnesota at Cloquet on September 18, Cunningham and C. H. White respectively gave talks on the probable markets for Minnesota lumber as a result of the defense program and the use of lumber from portable mills in farm building.

# FOREST SURVEY

## Appalachian

Inventory. The basic tables of area and volume have been computed for the Coastal Plain and Piedmont units of Virginia. A summary of the findings is given in the following tables:

Total Forest Area by Survey Units

| Unit              | Total area     | Total forest area |                | Commercial forest area |
|-------------------|----------------|-------------------|----------------|------------------------|
|                   | <u>M acres</u> | <u>M acres</u>    | <u>Percent</u> | <u>M acres</u>         |
| Coastal Plain     | 6,363          | 3,944             | 62.0           | 3,919                  |
| Southern Piedmont | 5,642          | 3,428             | 60.8           | 3,422                  |
| Northern Piedmont | 4,424          | 2,504             | 56.6           | 2,406                  |

Distribution of Forest Area by Type and Condition

| Unit              | Types          |                | Condition      |                   |
|-------------------|----------------|----------------|----------------|-------------------|
|                   | Pine           | Hardwoods      | Sawlog size    | Under-sawlog size |
|                   | <u>Percent</u> | <u>Percent</u> | <u>Percent</u> | <u>Percent</u>    |
| Coastal Plain     | 61.6           | 38.4           | 63.2           | 36.8              |
| Southern Piedmont | 54.0           | 46.0           | 48.8           | 51.2              |
| Northern Piedmont | 37.7           | 62.3           | 43.3           | 56.7              |

## FOREST SURVEY (cont'd.)

Saw-timber Volumes (International  $\frac{1}{4}$ -inch rule)

| Unit              | Softwoods      | Hardwoods      | Total          | Average volume per acre |
|-------------------|----------------|----------------|----------------|-------------------------|
|                   | Million bd.ft. | Million bd.ft. | Million bd.ft. | Bd. ft.                 |
| Coastal Plain     | 7,919          | 3,829          | 11,748         | 3,000                   |
| Southern Piedmont | 2,311          | 2,529          | 4,840          | 1,410                   |
| Northern Piedmont | 838            | 1,932          | 2,770          | 1,150                   |

The average volumes per acre in both the Coastal Plain and Piedmont units are considerably lower than the averages for corresponding areas in North Carolina and South Carolina.

Growth. The procedure previously used for growth computations has been revised for the Virginia units to permit calculation of growth by species and diameter groups so that more specific information can be obtained regarding the relation of growth and drain by species and size. Growth computations on this basis are approximately 70 percent completed for the Virginia Coastal Plain Unit.

Drain. The inventory of primary wood-using industries in Virginia, made in cooperation with the Bureau of the Census, has been completed. Approximately  $15\frac{1}{2}$  man-months were required to make the mill-to-mill canvass and 3,175 Census schedules were forwarded to Washington after being edited and checked in the Asheville Office.

In North Carolina and South Carolina field follow-ups were made to obtain 1940 production records for sawmills that failed to reply to the Census questionnaire. The final records show that only one-third of the mills cutting slightly over one-third of the production replied to the mailed questionnaire. A total of 9 man-months was required to field check the delinquents. The number of schedules received for each state is as follows:

|                         | <u>North Carolina</u> | <u>South Carolina</u> | <u>Total</u> |
|-------------------------|-----------------------|-----------------------|--------------|
| Received by mail        | 1,272                 | 360                   | 1,632        |
| Obtained by field check | <u>2,464</u>          | <u>1,116</u>          | <u>3,580</u> |
| Total                   | 3,736                 | 1,476                 | 5,212        |

The drain field men also obtained records of the quantity of wood used in 1939 and 1940 by the non-lumber wood-using industries such as pulp mills and veneer plants so that Survey drain records for these years can be brought up to date.

## FOREST SURVEY (cont'd.)

At each sawmill visited in North Carolina and South Carolina the lumber production for the early part of 1941 was obtained as a basis for estimating total 1941 production. Although the final figures are not yet available, preliminary estimates indicate that in these two states the 1940 lumber production was 11 percent and 1941 production 28 percent greater than the cut in 1939.

Reports. The North Carolina State Report was completed and forwarded to reviewers for comment, and work was started on unit reports for the Coastal Plain and Piedmont units of Virginia.

### Lake States

Forest Resources of the Upper Peninsula of Michigan. The long-awaited report by Cunningham and White (Misc. Publ. 429) on the Upper Peninsula of Michigan, which was printed in August, shows that of the eleven million acres of land in the Peninsula, about 90 percent is still forest land. With 2,400,000 acres in saw timber and a stand of 23 billion feet, this unit has more large timber than any other section of similar size in the Lake States. However, in view of the relatively slow growth and the rapidity with which the present stands are being cut off, it is predicted that one-half to three-fourths of the present wood-using industries will have to close during the next 20-30 years if the present trends continue. This situation can still be remedied if the present undesirable cutting methods are supplanted by selective logging accompanied by the creation of sustained yield units and readjustments in mill production and land ownership.

Forest Situation in Oneida County, Wisconsin. At the request of the Oneida County Land Use Planning Committee, Macon and Diemer have gotten together estimates of volume and growth and data on the forest industries of that county. These serve as the "meat" of Economic Note No. 14 which, using these figures as a background, recommends the measures necessary to restore the forests to their rightful place in the economy of the county.

### Northern Rocky Mountain

General. The new chief of the division of forest economics, R. W. Nelson, spent several days in the field with Bradner and Winters getting first hand information on the economic problems of the region.

Inventory. By the time this report is released, initial field work will have been completed for the Inland Empire, an area embracing some 32 million acres of which 25.4 million acres is forest land. Mapping of

## FOREST SURVEY (cont'd.)

the remaining 260 thousand acres in Granite County will be completed some time in October.

Owing to the reduced WPA program, no field progress has been made in Eastern Montana since the last report.

Compilation of field data for Missoula County is 85 percent complete, and this phase of the work has been started in Lewis & Clark and Powell Counties.

The first of a new series of survey reports, "Statistical Service," was issued in August. It is planned to prepare such reports, consisting of 8-10 pages of statistical information, for each county in Western Montana. They will provide a means of releasing completed statistical data without the delay attendant with more exhaustive reports and make a handy reference for readers interested in purely factual data.

### Pacific Northwest

General. A number of special projects developed during the summer, mainly as a result of the defense program. Despite this diversion satisfactory progress was made in the field on the county reinventories.

Prominent on the list of special projects was participation in a study of Industrial Defense Problems in the Pacific Northwest being conducted by the Pacific Northwest Regional Planning Commission under leadership of Dr. Blair Stewart; this project is still in progress. Assistance was also given the special commission appointed by the National Defense Mediation Board to study and report on certain phases of the Douglas-fir lumber industry bearing upon labor conditions. This committee is composed of Dr. Dexter Keezer, Chairman; Dean Wayne L. Morse, and Dr. Paul Eliel. It is anticipated that the survey staff will be drawn deeper into this study this fall. Data on supply of Sitka spruce and old-growth Douglas-fir were furnished Major J. W. Ferguson of the Army Air Corps.

The work of regional and State planning agencies has been prominent in this region. The availability of forest resource data for regional, State, and local units has been a considerable factor in shaping their studies, many of which have reached the publication stage. Publications reviewed during the past four months included "Preliminary Statement, Regional Development Plan, Pacific Northwest", and Parts III and IV of "Development of Resources and Economic Opportunity in the Pacific Northwest" entitled "Industrial Development of the Pacific Northwest" and "A Plan and Program for Regional Development and Internal Improvements in the Pacific Northwest", respectively. All three of these reports are publications of the Pacific Northwest Regional Planning Commission. The community self-analysis studies being conducted by the Washington State Planning Council are arousing national interest. The preliminary report of the

## FOREST SURVEY (cont'd.)

first of these, the so-called Elma Study has been reviewed. Copious use of survey data was made. The second, the Upper Skagit Valley Study, was under way this summer at the same time Buell was reinventorying Skagit County. He gave considerable aid to the study and as the new inventory figures become available they will be contributed.

Cowlin attended meetings of the Washington State Planning Council and Pacific Northwest Regional Planning Commission held jointly with members of the National Resources Planning Board August 15 and 16 at Olympia, Washington.

Other jobs included compilation of data on hemlock and balsam firs suitable for plywood manufacture for use in the cooperative study being conducted by the Madison Laboratory, Douglas Fir Plywood Association, and this Station. Data concerning lands eligible for classification under the Oregon and Washington reforestation laws were brought up to date. Among new users of survey data were attorneys for the Securities Exchange Commission. The rapid expansion of logging and lumbering has increased several fold the number of requests for type maps and statistics. A noticeable increase in requests for maps, reports, and other information has come in the past month from educational institutions. Many primary, high schools, and colleges of the Pacific Northwest are offering for the first time courses in Regional Resources of the Pacific Northwest. The genesis of this activity can be traced to the fine work of the Northwest Regional Council of Education, Planning, and Public Administration and the Summer School Workshops held at the University of Washington and Reed College the past two years.

Cowlin worked with members of the Regional Forester's staff in revising estimates of timber subject to provisions of the Pierce Bill. Changes in stumpage prices and rapid advance of timber depletion made this work necessary.

### Douglas-Fir Region

Keeping Findings Current. Field work was completed for Island, King, San Juan, Skagit, and Whatcom Counties, Washington. All western Washington counties have now been reinventoried except Clark and Skamania Counties on the Columbia River. These two counties are relatively unimportant and have very little available saw timber.

Compilation of type areas and timber volumes has been completed for Mason County, Washington. Publication of reports for Mason and Jefferson Counties has been held up to correlate survey inventories with recent examinations of national forest timber by Regional Office and Forest personnel.

Interpretation and Analysis. Flood of special jobs delayed the Grays Harbor unit study somewhat but basic computations were practically completed and the analysis and report writing stages can now proceed.

## FOREST SURVEY (cont'd.)

Correlation of survey cover type data with tax delinquency data collected by Wilson and staff was completed and generalized forest types were brought up to date for cutting as of January 1, 1941.

Growth Studies. A comprehensive attempt to improve the methods of making survey growth estimates was started last summer under the leadership of J. W. Girard, and one crew month of field work in the immature Douglas-fir type of Skamania, Lewis, Grays Harbor, and Cowlitz Counties in Washington, Yamhill, and Polk Counties, Oregon, was completed. The method employed was similar to that devised by Girard and used successfully on the growth phase of the survey in Region 1. Growth of immature stands was sampled mechanically, the stocking and age classes as mapped on the inventory phase forming the sampling universes. Growth measurements were taken on some 3,800 sample trees on 186 sample plots.

In order to check the method of mortality and growth determination employed, estimates were made on the ground on the Station's permanent sample plots and compared with the plot records of actual growth and loss. The difference between measured and estimated net growth (during the last 10 years) averaged about 5 percent.

Preliminary analyses of results are being made to provide a guide for future field work on this study, which, it is planned, will be extended to other west side counties and concluded next field season.

### Extracts from Findings

Inventory Revision. Completion of the revised inventories of Jefferson and Mason Counties, Washington, makes available data on the entire Olympic Peninsula, the location of one of the great reserves of standing timber in western Washington. The establishment of the Olympic National Park between the original and revised inventories materially changed the availability of this timber reservoir. The following table contrasts the two inventories. The net depletion of 7.3 billion board feet gains added significance when it is localized; 7.1 billion feet occurring on private lands. The volume of privately owned Douglas-fir was nearly halved between 1933 and 1940. During 1940 sawlog drain in these four counties totaled 1,161 million board feet, of which 648 million feet was Douglas-fir. Chances are these figures will be exceeded considerably in 1941.

# FOREST SURVEY (cont'd.)

Comparative saw-timber volume in Olympic Peninsula counties 1/  
Millions of board feet, log scale, Scribner rule

|                                  | Private   | National forest | National |        |        |        |
|----------------------------------|-----------|-----------------|----------|--------|--------|--------|
|                                  | Available | Reserved        | park     | Other  | Total  |        |
| Douglas-fir                      |           |                 |          |        |        |        |
| Original inventory <sup>2/</sup> | 7,966     | 12,265          | 4        | ---    | 1,319  | 21,554 |
| Revised inventory <sup>3/</sup>  | 4,035     | 6,169           | 153      | 5,707  | 1,097  | 17,161 |
| Pulp species                     |           |                 |          |        |        |        |
| Original inventory               | 17,247    | 22,242          | 72       | ---    | 9,727  | 49,288 |
| Revised inventory                | 14,579    | 10,931          | 570      | 10,626 | 9,896  | 46,602 |
| All other                        |           |                 |          |        |        |        |
| Original inventory               | 3,473     | 2,450           | 7        | ---    | 2,716  | 8,646  |
| Revised inventory                | 2,912     | 1,184           | 68       | 1,170  | 2,866  | 8,200  |
| Total                            |           |                 |          |        |        |        |
| Original inventory               | 28,686    | 36,957          | 83       | ---    | 13,762 | 79,488 |
| Revised inventory                | 21,526    | 18,284          | 791      | 17,503 | 13,859 | 71,963 |

1/ Grays Harbor, Mason, Jefferson, and Clallam Counties, Washington.

2/ Original inventory as of January 1, 1933, in all counties.

3/ Revised inventory of Grays Harbor County as of 1937, except national forest and national park ownerships which are as of 1940; Clallam, Mason, and Jefferson Counties as of 1940.

Growth Studies. The curves derived from the past season's work need to be strengthened by additional data. As they now stand, however, the preliminary growth rate correction factors indicate that previous methods have resulted in substantial underestimates in growth of young stands, both medium and well stocked. In the advanced age classes it appears the growth of well-stocked stands has in the past been somewhat overestimated, owing to acceleration of mortality with age; that of medium-stocked stands slightly underestimated. Application of these correction factors would undoubtedly result in substantially increased growth estimates in some units, slightly reduced estimates in others, and considerable increase for the region as a whole.

# FOREST SURVEY (cont'd.)

## Preliminary growth rate correction factors

| Age   | : | Well-stocked stands | : | Medium-stocked stands |
|-------|---|---------------------|---|-----------------------|
| Years | : | Percent             | : | Percent               |
| 30    | : | 1.42                | : | 2.05                  |
| 40    | : | 1.29                | : | 1.71                  |
| 50    | : | 1.19                | : | 1.50                  |
| 60    | : | 1.11                | : | 1.37                  |
| 70    | : | 1.05                | : | 1.27                  |
| 80    | : | 1.00                | : | 1.21                  |
| 90    | : | .95                 | : | 1.16                  |
| 100   | : | .92                 | : | 1.13                  |
| 110   | : | .88                 | : | 1.11                  |
| 120   | : | .86                 | : | 1.09                  |
| 130   | : | .84                 | : | 1.08                  |
| 140   | : | .81                 | : | 1.07                  |
| 150   | : | .80                 | : | 1.06                  |
| 160   | : | .78                 | : | 1.05                  |

## Southern

General. Captain Eldredge prepared the Forestry Section of the National Resources Planning Board Report for the Southeastern Section and sent it to the Regional Office, Appalachian Station and T.V.A. for review and comments.

The loss of the WPA project at the end of June has greatly reduced the producing capacity of the Survey organization here. Our computing, stenographic and drafting sections have been reduced to approximately 40 percent of their former effectiveness. This has necessitated the dropping of all work on naval stores analysis, studies of distribution and density of principal tree species, and revision of county estimates. It has resulted in a 25 to 30 percent reduction in growth and drain work and raises a question of the feasibility of the station making a field follow up of delinquents in 1942 in cooperation with the Bureau of the Census. Lack of funds has also resulted in the closing of the multilith department which will seriously affect the appearance and attractiveness of our future Survey Releases and Occasional Papers.

Wheeler finished the rough draft of the Mississippi Unit #2 report and it is now being reviewed by Eldredge. The Mississippi Unit #1 report has been reviewed by Eldredge and is awaiting its first check.

Ineson spent the entire month of June in Washington working on the study of the financial structure of wood-using industries and other

## FOREST SURVEY (cont'd.)

problems. On his return to New Orleans, he continued work on the report of the financial structure study and on the Florida State report and revision of the Louisiana State report.

In early June, Wheeler visited the Appalachian Station and discussed Survey cooperation with Roberts and his staff. The Louisiana State report was given its second and final check under his supervision and good progress was made on the recomputation of county forest areas and volumes for the states of Florida, Alabama, and Mississippi, which was necessitated by the new land area figures published by the Census.

An intensive field follow up of the 1940 Census of lumber production, begun May 1, was brought almost to completion for the states of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, and Texas. In all, 575 counties were covered. In 113 counties the follow up was handled by cooperating national forest personnel and by the Alabama State Forest Service. In 462 counties the work was handled by Forest Survey personnel, including three temporary employees engaged for a three-months period. Regular Survey staff men engaged on the field follow up included Snyder, Davis, Wheeler, and Stover. A preliminary summary of returns for the 1940 census of lumber production follows and shows need for field contacts:

|   |              |
|---|--------------|
| Questionnaires returned voluntarily by mail | 3,282        |
| Questionnaires obtained by field follow up  | <u>7,118</u> |
| Total returns                               | 10,400       |

## FOREST TAXATION AND INSURANCE

### Pacific Northwest

The local government report for Washington entitled "Planning the Local Government of the Future with Special Reference to Wild Land Areas in the State of Washington" is now practically completed. Special emphasis is placed on the possibility of a State-administered wild land area outside of any local government or district boundaries where stability in taxation would remove a handicap to private forestry. Free use has been made of illustrations from Alaska and British Columbia as well as from Maine.

There is considerable interest in local government reorganization in Oregon. The Governor's Interim Committee on Tax Policy will recommend to the next legislature some government reorganization proposals. A committee has been appointed in the Portland Chamber of Commerce to study the consolidation of functions and reorganization of local government units; of this Wade DeVries has been named chairman. Because of the great importance of the educational function in local government, the committee will confine itself to a study of school district organization affairs for the present. It is possible that the work of this committee will directly supplement the local government project of this Station.

Contribution in lieu of taxes and the taxation of Federal property continue to be live subjects in the Pacific Northwest. An article entitled "Federal Forests and Local Taxes" by E. H. MacDaniels, published in the Oregon Voter and resting in part upon material developed by the Station, shows the lack of any association between a high degree of Federal ownership and high rural tax rates. Nevertheless Oregon counties are contributing to a Washington lobby working for the removal of Federal property from its tax-exempt status.

The chief activity during the summer in connection with the Oregon Forest Fee and Yield Tax law was declassification hearings at St. Helens, Oregon. These hearings were held for the purpose of considering arguments and discussions as to whether certain classified land had greater value for stock raising than for timber growing. From a study of the minutes of these hearings it would seem that the intent of the owner plays a large part in determining the question of classification or declassification. It is reported by the State Forestry Department that a maximum of one sheep to eight acres or one cow to 40 acres can be allowed without detriment to forest growth. It is presumed that this rule will also play a part in selecting lands for classification and declassification. The State Forester is receiving many applications for declassification

## FOREST TAXATION AND INSURANCE (cont'd.)

because piling and other forest products are coming to have merchantable value on lands which had not been assessed for their timber previous to classification. These applications are usually rejected on the grounds that no error in classification is shown, and the yield tax is collected when the merchantable growth is harvested.

A recent publication of the Pacific Northwest Regional Planning Commission, National Resources Board, "Taxation of Industrial Corporations in Washington and Oregon", by James C. Rettie, devoted three pages to a summary of Wade DeVries' "Rural Property Tax Rates for 1940 in Oregon and Washington Counties", November 1940, and says, "This publication is recommended as the best available analysis of prevailing rural property tax rates in the two States."

### Southern

After consultation with State Forester Murray Brashears, Craig selected the following nine parishes (counties) in Louisiana as samples for his tax-index study in that state--Webster, Sabine, Jackson, Richland, Washington, La Salle, Concordia, Beauregard, and St. Landry. These parishes are representative of varied forest types, condition classes, and ownership patterns, and provide a well-distributed sample of the state.

Field work in cooperation with the Division of Forestry, Louisiana Department of Conservation, was begun in Webster Parish in June. To date the first five parishes listed above have been completed, both in field and office. La Salle and Concordia will be completed in October and the last two parishes in November. Great difficulty has been encountered in some parishes in arriving at valid figures on assessed values per acre by condition-classes, because of the lack of reality in timber classifications set up by local assessors, and the none-too-clear bases of the land classifications set up by state law. In other parishes, nevertheless, the local authorities, operating within the same legal framework, have evolved a sound and equitable system of assessment. Great differences have been noted among the parishes in the concepts of forest land values and also in tax rates.

Arrangements have been perfected for obtaining the 1941 tax-index data in the nine Alabama counties covered last year. These data are being obtained in the field by the district foresters and rangers of the Division of Forestry, Alabama Department of Conservation, and sent to Craig for analysis and publication.

It is planned to issue the data for both states as an Occasional Paper about January 1, under the title: "Taxes on forest property in nine parishes of Louisiana, 1937-40, and in nine counties of Alabama, 1938-41."

## NEW PUBLIC DOMAIN

### Pacific Northwest

Some progress was made on the latter parts of the general New Public Domain report and copies of earlier parts were forwarded to Washington for review. Brief field inspections of tax reverted and reverting lands were made in several places in Oregon and Washington to examine their physical condition and to devise ways of speeding up the processes of disposal for best long-time ownership and use. Additional services on rural zoning were rendered in response to request by the Oregon Economic Council organized by Governor Sprague; the whole subject is revived by recognition of acute land area problems in suburban areas and along principal highways--heretofore attention has been centered on forest and range areas.

Under the Grays Harbor unit study, being conducted by several divisions of the Station and headed by Forest Survey, new public domain field investigations were completed and office work undertaken. Tax delinquency data cover 98 percent of the total land area within the unit. They have been correlated with generalized cover data by the Forest Survey staff and analysis is under way.

Many significant situations pertaining to the unit in general and to Grays Harbor County in particular are revealed. Several of those pertaining to the former are discussed here in advance of final checking and formal release.

Within the portion studied land forfeited for unpaid taxes and still in public ownership, hereinafter termed tax-reverted land, and land in private ownership totaled approximately 1,419,000 acres as of January 1, 1941. Of this amount 198,000, or 14 percent, was tax reverted; 239,000, or 17 percent, private involved in long-term tax delinquency (2 or more years); 44,000, or 3 percent, private involved in short-term tax delinquency (less than 2 years); and 938,000, or 66 percent, private not tax delinquent.

Most of the tax-reverted lands were acquisitions of 1939 and 1940 following a relatively long period during which tax-foreclosure sales had been stayed except for short intervals by legislative and administrative action. As to lands involved in long-term delinquency, 158,000 acres was under written tax agreements legally reducing interest and penalty charges and extending the period of delinquency considerably beyond the ordinary statutory period. In each of these instruments the owner agreed to pay current taxes when due and pay up back taxes in instalments, and the county concerned agreed to stay foreclosure provided the terms were observed. Current and back taxes were being paid on most of the acreage under agreement.

To what extent foreclosure stays and tax agreements combined increased or decreased the sum total of acreage delinquency and reversion cannot be said. Foreclosure stays on lands not under tax agreements may have helped some owners pay their way out of delinquency, but in the main they encouraged delinquency, permitted an inordinate accumulation of back taxes and resulted in unloading a large acreage on the county when foreclosures were resumed, thereby increasing their disposal problems. Tax agreements helped some tax delinquent owners pay their way completely out of delinquency and afforded others a longer time than usual in which to decide whether they should hold their lands, could sell them or would abandon them. At the same time tax agreements encouraged delinquency by their concessions and greatly increased an already heavy work load imposed upon tax collectors.

Tax delinquency involved both forest and nonforest types but centered definitely around the forest. Private ownership of forest types was less stable than private ownership of nonforest types. Nonforest comprised only 6.8 percent of the total acreage, 2.4 percent of the tax-reverted acreage, and 6.2 percent of the acreage involved in long-term tax delinquency, while the corresponding figures for forest were 93.2 percent, 97.6 percent, and 93.8 percent. Of the nonforest only 4.8 percent was tax reverted as against 14.6 percent of the forest.

Among the forest types, commercial conifers presented the most serious tax delinquency problem because of total acreage and obvious present and potential utility. They comprised a total of 1,252,700 acres as against 56,900 acres of hardwood and 12,400 acres of noncommercial types. Of the commercial conifers, tax reverted totaled 184,200 acres; long-term delinquency, 207,500 acres; and short-term delinquency, 29,900 acres. The corresponding data for hardwoods were 5,400 acres, 13,100 acres, and 3,900 acres, respectively. Those for noncommercial forests were 3,500 acres, 4,300 acres, and 900 acres, respectively.

As to the commercial conifers, considerable bodies of each of the four generalized types--saw-timber, pole, sapling, and deforested--were involved in tax delinquency (see table). The delinquency situation in the saw-timber type was more severe than expected but in volume and proportion was less acute and extensive than in the other three. The other three comprised 60.1 percent of the total commercial conifer area, but 87.2 percent of the tax reverted lands, 76.8 percent of long-term delinquents under tax agreements, 74.9 percent of long-term delinquents not under agreements, and 77.8 percent of short-term delinquents. Only 1/20 of the saw-timber acreage was tax reverted as against over 1/4 of the pole, slightly under 1/4 of the sapling and 1/8 of the deforested. Less than 1/8 of the saw-timber acreage was involved in tax delinquency (reverted or delinquent) as

# NEW PUBLIC DOMAIN (cont'd.)

against over 1/2 of the pole, over 2/5 of the sapling and over 2/5 of the deforested. Two more significant facts: (1) short-term delinquency is relatively light in each of the four types; (2) long-term delinquency under tax agreements exceeded long-term delinquency not under tax agreements by a wide margin.

Area of tax reverted and of private commercial conifer lands delinquent and not delinquent for taxes levied in 1939 and prior years by generalized types, as of January 1, 1941

| Tax delinquency status                      | Types 1/    |         |         |             |       |           | Total |
|---|-------------|---------|---------|-------------|-------|-----------|-------|
|   | Saw-timber: | Pole    | Sapling | Deforested: |       |           |       |
|   | size        | size    | size    | size        |       |           |       |
|   | Acres       | Acres   | Acres   | Acres       | Acres | Acres     |       |
| Tax reverted <sup>2/</sup>                  | 23,515      | 51,400  | 60,755  | 48,510      |       | 184,180   |       |
| Private delinquent--long term <sup>3/</sup> |             |         |         |             |       |           |       |
| Under tax agreements                        | 32,250      | 26,295  | 34,060  | 46,055      |       | 138,660   |       |
| Not under tax agreements                    | 17,260      | 13,490  | 10,070  | 27,980      |       | 68,800    |       |
| Private delinquent-short term <sup>4/</sup> |             |         |         |             |       |           |       |
| Total reverted & delinquent                 | 79,675      | 101,275 | 112,365 | 128,210     | 5,665 | 29,885    |       |
| Private not delinquent                      | 420,570     | 94,190  | 150,930 | 165,455     |       | 421,525   |       |
| Total reverted and private                  | 500,245     | 195,465 | 263,295 | 293,665     |       | 831,145   |       |
|   |             |         |         |             |       | 1,252,670 |       |

1/ Saw-timber size: usually over 20" d.b.h. Pole size: usually 6-20" d.b.h.

Sapling size usually under 6". Deforested: deforested burns, old clear cuts not restocking and recent clear cuts.

2/ Forfeited to the county for unpaid taxes and still in public ownership.

3/ Delinquent for taxes levied in 1938 or prior years.

4/ Delinquent for taxes levied in 1939.

Although 197,800 acres of all types was tax reverted, 162,800 acres, or 82.3 percent, was in indefinite county ownership--undecided, unmanaged, without benefit of official classification as to desirable ownership and use, and in all but a few cases unappraised. Only 16,200 acres, or 8.2 percent, was transferred and dedicated to public purposes--15,700 to State forests and 500 to Federal ownership--and yet the majority of reverted properties are near to organized State and Federal forests.

Another 18,700 acres, or 9.5 percent, was in county ownership in process of disposal to private persons under contracts of sale. Of these, 16,600 acres, or 8/9 was commercial conifer and 10,600 acres, or 2/3 were pole and larger types. In the majority of contracts checked the total consideration in each was less than the unpaid taxes that had accumulated against the land prior to foreclosure and less than the assessed valuation of comparable property. (Washington law provides that assessed valuation be 50 percent of full value.) Again in the majority of cases the initial payment was 20 percent of the total consideration. Many of the contracts were less than one year old, but most of the older ones were delinquent both as to interest and principal payments and as to taxes on the equities. On several of the older contracts no more than the initial 20 percent had been paid upon principal.

Of the 162,800 acres in indefinite county ownership, 152,200 acres, or 93.5 percent, was commercial conifer types as follows: Saw-timber size, 18,700; pole size, 42,900; sapling size, 51,500; deforested, 39,100. All are in prompt need of good management and hence in need of its component, definite stable ownership.

Planning. Cooperation with the Pacific Northwest Regional Planning Commission and the Portland Chamber of Commerce continued. With the aid of the Northern Rocky Mountain and the Intermountain Stations numerical data and several paragraphs on farm woodlands, in Idaho, Montana, Oregon, and Washington, were prepared for the forthcoming Planning Commission report entitled "Agricultural Land Development in the Pacific Northwest."

### Southern

In May Craig assisted a subcommittee of the Mississippi Agricultural Planning Committee, at its request, in drafting a report and making broad recommendations for legislation in the field of tax delinquency, aimed (1) at removing or alleviating those causes of chronic tax forfeiture arising through faulty or inequitable assessment and tax collection procedures and (2) at the most economic disposal or long time use of lands passing to state title through forfeiture. This report, with recommendations, was accepted by the State Committee and included in its formal report to the National Resources Planning Board.

## NEW PUBLIC DOMAIN - (cont'd.)

At the request of the State Forester of Oklahoma, Craig assisted him in August in organizing a study of the current tax status of rural land in the eight principal timbered counties of eastern Oklahoma. One of the recommendations made by Craig as a result of his tax-delinquency study in 1938 in that state was that the law requiring each county to hold an annual tax certificate sale and an annual resale be strictly enforced, in order to prevent (1) the building up of tax debts against low value forest land to a point beyond the value of the land, and (2) the building up of fictitious "watered" assessment bases through failure to remove assessed values of delinquent lands from the tax rolls. In 1939 the Legislature passed an act making such sales mandatory under severe penalties for non-compliance or improper compliance. County officials in 1940 and 1941 have complied by holding certificate sales and, where possible, resales. It is the effect of this new procedure on the tax status of rural lands in the forest counties which is being studied. Rangers of the State Forest Service are obtaining data on (1) area originally bid in by county at resales of 1941 or earlier years, (2) area still in county title as of date of survey, (3) area sold by County Commissioners' deed, (4) character of land sold, use contemplated, sales price, and similar information. These data on Delaware, Cherokee, Adair, Sequoyah, Le Flore, Latimer, Pushmataha, and McCurtain counties, will be forwarded to Craig for analysis and the preparation of a report.

## PRIVATE FORESTRY

### Central States

Illinois Farm Woodland Study. The tables dealing with pastures and buildings were prepared in first draft. Also some of the farm summary tables were made up. A portion of the manuscript for the pasture section was prepared.

### Northeastern

Farm Forestry-Connecticut. Installation of equipment for burning hogged fuel at the Niantic State Farm for Women is underway. All equipment and materials are available with the exception of a flight conveyor to carry the fuel from the storage bin to the burner. Defense preference ratings have prevented the ordering of the conveyor. Arrangements for the hogging operation have been completed and when installation of burning equipment is completed tests will be started.

Seasoning rates of fuelwood of various lengths and diameter both split and round have been completed and a report of results is

under way. The data indicate that splitting has a considerable influence in accelerating the seasoning rate of oak fuelwood. The application of this information will be especially useful where grading is practiced by separating cleft and round wood.

The loan of three new-type wood heaters has been arranged. Efficiency tests will be started with the heating season.

Two of the heaters are being produced commercially and are available to the public. The third heater is in the experimental stage.

A report on the construction and operation of portable charcoal kilns is soon to be published as a Connecticut Agricultural Experiment Station bulletin. One of the experimental kilns is now being used by a private woodland owner which should yield further information on its operation under service conditions.

### Southern

Little-leaf survey. Swarthout spent most of the summer in cooperation with W. R. Boggess of the Alabama Station and E. R. Toole of the Bureau of Plant Industry, digesting the field data taken last May by a joint field party of several agencies in a survey of little-leaf disease of southern pines in two selected areas in Alabama. One area was 8 x 15, the other 8 x 30 miles. A 15-page summary was issued as a Departmental Mimeograph by the Alabama Station on September 28. In one area 16 percent (4,121,000 board feet) of the pine sawtimber volume, and in the other area 27.5 percent (17,684,000 board feet) in trees is infected with little-leaf; in the latter area, 51.5 percent of the total shortleaf sawtimber volume was infected, 20.2 percent to an advanced stage. These figures exclude cordwood volumes not merchantable as sawtimber, and all trees already dead from little-leaf. The disease was found on 30 soil series, seemingly increasing in severity on the poor soils (more than 70 percent of cubic volume affected on some soils.) Fire, erosion, steep slopes, and low site index were all associated with a high percentage of infection; short-leaf pine was more severely affected than loblolly pine and much more so than longleaf; and dominant and codominant trees were more susceptible than intermediate and suppressed. Trees under 20 years were seldom diseased.

### Southern

Farm Woodland Study. Bond completed the analysis of a timber inventory, growth study, and canvass of farm uses and sales of timber products from 70 sample farms in Hempstead County, Arkansas, and

## PRIVATE FORESTRY (cont'd.)

prepared a report, "Forestry as a Supplemental Farm Enterprise in Hempstead County, Arkansas." This report will be used as a chapter in a bulletin, covering a comprehensive Bureau of Agricultural Economics-State Agricultural Experiment Station farm management study in that county, which is to be published by the University of Arkansas.

Most of the farms in Hempstead County fall into a 40- or an 80- acre size class. The farm woodland on the usual 40-acre farm occupies only 11 acres and on the 80-acre farm 21 acres. The predominating timber type is shortleaf-loblolly pine and hardwoods. Of the 70 farm woodlands inventoried, 68 percent had understocked stands averaging about 1,000 feet (Doyle rule) of saw timber (both pine and hardwood) per acre, 10 percent had reasonably well-stocked stands averaging about 3,300 feet per acre, and 22 percent had heavily depleted stands composed largely of culls and unmerchantable species. In spite of general mistreatment and overcutting the usual farm woodland, although seriously deficient in trees of saw-timber size, has restocked with young growth.

With good management of the average 21-acre woodland, the farmer during the next 5-year period can produce and sell a total of 5,775 board feet of sawlogs, worth \$40.43 after felling and bucking into logs, and besides cut each year the home needs of about 11 cords of fuel wood and 100 fence posts. After 6 cutting cycles of 5 years each, with each cut taking only 20 percent of the saw-timber volume, the sixth cut is estimated at about 18,800 feet of logs worth about \$131.00 and 8 $\frac{1}{2}$  cords of stacked pulpwood worth about \$15.00 besides the home needs of fuel wood and fence posts. This periodic income of about \$146.00 for the 21-acre woodland is equivalent to approximately \$1.40 per acre per year. Because each cut was limited to 20 percent of the saw-timber volume, which is considerably less than the growth, the growing stock during the 6 cutting cycles will have been built up from about 1,000 feet per acre to about 3,600 feet, which is better than that now found on the best 10 percent of all woodlands. On a per acre basis the total amount of the 6 cuts are estimated at 3,700 feet and the total growth added to the growing stock at about 2,600 feet, making the total growth for the 30 years about 6,300 board feet per acre, or an average of about 210 feet per acre per year.

The low incomes to be expected from 21-acre woodlands, even when built up to fair stocking, represent only a modest advance toward improving the general farm economy. The possibility of increasing the size of the woodland is worthy of consideration. The farmer and his family have a sufficient number of days, unemployed in any farm enterprise, to manage and cut 200 acres of well-stocked farm woodland. Good management of such a woodland should yield approximately the following annual cash income:

## PRIVATE FORESTRY (cont'd.)

|                     |                 |
|---------------------|-----------------|
| 37,600 feet sawlogs | \$263.20        |
| 47 units pulpwood   | 82.25           |
| 380 ties            | 114.00          |
| 25 cords fuel wood  | 50.00           |
| Total               | <u>\$509.45</u> |
| Per acre            | 2.55            |

Although there is a large acreage of nonfarm woodland in the county, the average farmer does not have cash or credit with which to purchase enough acreage to bring his total area up to 200 acres. Furthermore, until farmers have been convinced through practical demonstration, that farm forestry will pay them for their efforts, they will not generally adopt good forestry practices. Available technical services, needed both for an educational program and for an action program to assist farmers in forest management, are very limited. Consequently, even though this expansion of the farm woodland appears as a promising farm adjustment, the effectuation of such a program by our present efficient but inadequate extension agencies cannot be expected for some time.

Farm Woodland Management. Reynolds, at the invitation of Monty Payne, Extension Forester of Mississippi, took part in the Soil Conservation training course program, held at State College, Mississippi, September 4, 5, and 6. A paper, "Some Principles of Farm Woodland Management," was presented and later published in "Farm Research" at State College, Mississippi. Extension Forester Monty Payne also distributed mimeographed copies to farmers in Mississippi.

## RANGE ECONOMICS

### Intermountain

Tax Costs on Range Land in Central Utah. High land values resulting in excessive interest costs and high taxes are a major factor causing overgrazing of private range lands. The central Utah economic study of the Range Economics Section has compiled some interesting material on range land tax costs. Table 1 shows the assessed valuation, taxes, tax per acre, and tax per A.U.M. on private range land in central Utah covered by the 1940 AAA range survey.<sup>1/</sup>

The first point of interest in table 1 is that there is no consistent relationship between productivity measured in A.U.M.'s of grazing and the assessed valuation. The data on individual tracts or blocks of range land in each county showed fully as great  
<sup>1/</sup> If there is any bias in these range surveys it is on the liberal side resulting in a lower acreage requirement per A.U.M.

## RANGE ECONOMICS (cont'd.)

a variation or inequality of assessed valuation as is shown between counties. Naturally, there are other factors besides the months of grazing that influence the value of range such as availability of stock water, fences, and other improvements, topography and distance to ranch and shipping point. However, grazing capacity is by far the most important factor in valuation.<sup>2/</sup>

There is considerable variation between counties in the mill levy. Piute County which was also included in this study, but which had only a few acres surveyed by the AAA, had the highest levy of 34.95 mills. This is 8.50 mills or about one-third higher than in Sevier, the adjoining county, with fairly similar range. The tax cost per acre varies widely as shown in table 1. The extreme range in counties is from 3.6 cents in Beaver to 8.6 cents in Carbon and Emery, a difference of 5 cents per acre. However, the variation between different tracts in the same county was also found to be very great.

The final and most important point in these data is the high tax cost per animal unit month of grazing. Note that in Emery County this is 31 cents per A.U.M. This is as much as or more than an operator can afford to pay in total land charges per A.U.M. Here again the variation between different tracts of range in the same county was extremely great. The lowest tax cost per A.U.M. was 7 cents. The variation in Millard County, for example, was from 7 to 86 cents per A.U.M.

Considering the amount a rancher can afford to pay for an animal unit month of grazing it is clearly evident that taxes on range land are very burdensome and tend to encourage overuse of the range. These data shows that taxes are not only too high but that there is little, if any, equality in the assessed value of range of similar productivity in this area. This results in inequality of the taxes per A.U.M.

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<sup>2/</sup> This might not be true in isolated cases such as where a "script forty" with a water hole on it made available the use of other range otherwise not usable.

# RANGE ECONOMICS (cont'd.)

Table 1.-Taxes per acre and taxes per animal unit month in central Utah counties, 1940.<sup>o</sup>

| County  | Acres covered | Grazing Capacity |                  | Assessed valuation | Mill levy | Total taxes | Tax per acre | Tax per A.U.M. |
|---------|---------------|------------------|------------------|--------------------|-----------|-------------|--------------|----------------|
|         |               | Total A.U.M.s    | Acres per A.U.M. |                    |           |             |              |                |
| Beaver  | 13,645        | 2,541            | 5.4              | \$ 16,195          | 30.65     | \$ 496.37   | 3.6¢         | 20¢            |
| Carbon  | 17,643        | 5,784            | 3.1              | 51,331             | 29.40     | 1,509.13    | 8.6¢         | 26¢            |
| Emery   | 7,866         | 2,165            | 3.6              | 20,381             | 33.30     | 678.69      | 8.6¢         | 31¢            |
| Millard | 25,253        | 4,422            | 5.7              | 35,073             | 27.00     | 946.89      | 3.8¢         | 21¢            |
| Sanpete | 31,050        | 8,108            | 3.8              | 59,530             | 34.15     | 2,032.95    | 6.5¢         | 25¢            |
| Sevier  | 26,475        | 6,470            | 4.1              | 58,711             | 26.45     | 1,552.88    | 5.9¢         | 24¢            |
| Total   | 121,932       | 29,490           | 4.1              | \$241,221          | 29.92     | \$7,216.91  | 5.9¢         | 24¢            |

<sup>o</sup>Grazing capacity of tracts secured from the 1940 AAA Range Program.

## STUMPAGE, LOG, AND LUMBER PRICES

### California

During the summer of 1941 effort of the Economics Division has been focused primarily on: (1) Contributions and Dependency Study in the East Side Pine Type in Modoc County; (2) Forest Employment Survey of California; (3) Survey of Lumber Used in Manufacturing; and (4) National Defense Supply and Requirements Work.

In connection with the latter, the following highlights stand out:

1. For the first six months of 1941 as compared to the same period in 1940, in the western pine region, production was up 15.8 percent; shipments up 21.3 percent; and stocks down 15.4 percent. In the redwood region consumption in the first half of 1941 was up 15 percent over the comparable 1940 period, whereas stocks were down 15 percent.

2. Shortages are developing in wooden boxes, Douglas fir plywood, and in seasoned ponderosa pine and Douglas fir lumber for non-defense uses. Production of box lumber is about the same as in 1940, although relatively there has been a decrease. But consumption of box shooks is up 10 percent, with the result that inventories are being used up. A price differential of from five to six dollars per thousand

## STUMPAGE, LOG, AND LUMBER PRICES (cont'd.)

in favor of common grades over box grades, plus priority ratings for defense orders discourages mills from manufacturing box lumber. Recently the Surplus Commodities Corporation requested 7,000,000 boxes for packaging dried prunes for European shipment, half of which were desired by the first of November. Fulfillment of this order would require about 15,000,000 feet of lumber. About 50 percent of the normal consumption of boxes on the Pacific Coast goes for citrus and vegetable boxes whereas at the present time direct Government orders comprise about 15 percent of the total demand.

3. Furniture manufacturers report difficulty in obtaining Douglas fir lumber and plywood, alder, cottonwood, sap gum and ponderosa pine. Production is reported up about 40 percent over a year ago. In some instances firms are substituting ponderosa pine plywood for Douglas fir plywood; sugar pine for ponderosa pine, and also, according to the trade, "California red fir" is being substituted for "Oregon pine". It is reported that the smaller manufacturers of alder lumber have found it more profitable to work in the large softwood mills, in direct defense industries, or have been drafted into the army. Sap gum is not being transported to the west coast in adequate quantities. Due to lack of cargo space, imports of Philippine mahogany have practically ceased despite large stock piles in the Islands. Substituted for it are magnolia and "southern cabinet ash".

4. Estimated one-shift annual capacity of pine mills in California is about 2,000,000,000 board feet, or one-third more than the estimated cut in 1940. Redwood mills have a reported eight-hour capacity of 2,755,000 board feet. If production holds in the last half of 1941 as it has in the first half, annual cut in California in 1941 will be close to 2,190,000,000 board feet, which would be an all time high.

5. Employment has risen steadily in the past year. In logging camps and sawmills it is up about 17 percent over July, 1939; in mill work and miscellaneous woodwork it is up 36 percent over the same period; in furniture, up 20 percent; and for all lumber and allied products roughly 20 percent more employees were on the payrolls in July 1941 than in July 1939. Moreover, few skilled or semi-skilled woodworkers are registered with the State Employment Offices. If labor demands continue to increase, a shortage may develop unless it is eased by the influx of workers from outside the State.

6. Car loadings, particularly of lumber, piling and ties, also reflect the accelerated industrial tempo. For example, in the last two quarters of 1940 lumber car loadings were up 18.5 and 31.8 percent respectively over the same quarters in 1939, and it is estimated by the Pacific Coast Transportation Advisory Board that third quarter lumber car loadings in 1941 will be up

## STUMPAGE, LOG, AND LUMBER PRICES (cont'd.)

28.2 percent over the comparable period in 1940. Thus, in two years, carloadings will have jumped about 50 percent.

7. Of the 54 lumber boats normally operating in the coastwise trade, 12 had been taken off by August for the off-shore trade to the Hawaiian and Philippine Islands and the Red Sea, partly by the Maritime Commission and partly by private charter. It is expected that by the first of the year there will be a total reduction of 50 percent in available tonnage for coastwise lumber shipment. In the inter-coastal trade 50 percent of the tonnage has already been requisitioned by the Maritime Commission; nor is all of the remaining tonnage without restrictions. For example, shippers must take large quantities of lumber monthly to the Panama Canal. Despite this reduction in shipping facilities, lumber can still be moved into California without undue delay by rail, although at a higher cost.

8. In summary, if bottlenecks develop they are most likely to occur in containers of various sorts, plywood, seasoned lumber of the common grades, machinery replacements in logging and manufacturing plants, and possibly shortages of skilled labor, and transportation facilities.

## FOREST MANAGEMENT RESEARCH

### FOREST FIRE PROTECTION

#### Allegheny

A mimeographed paper entitled "Applicability of the Appalachian Danger Rating System in Southern New Jersey" by Little, was published. This study shows that fire occurrence, size, and cost of suppression are closely correlated with the current danger rating classes as determined by the Appalachian Mountain Meter (Type 5-A). Even better correlation occurs if:

1. Fuel moisture sticks are exposed on the surface of the litter rather than on wire supports;
2. The factor, "Days since 0.50 inches or more of rain", is replaced by direct measurement of fuel moisture in the lower litter;
3. Wind velocity classes are reduced to correspond with those actually occurring under forest stands.

Fire weather predictions from the meter proved unreliable largely because regular weather forecasts give general air movement data which are inapplicable 80 percent of the time in and around forest stands.

## FOREST FIRE PROTECTION (cont'd.)

In addition to the detailed study briefly summarized above, a condensation of the findings is being prepared in popular language for distribution to New Jersey forest fire wardens and other interested people.

### Appalachian

Behavior. The mountain type fire danger meter has been revised, and an up-to-date instruction booklet for fire danger station observers has been prepared by Jemison. The booklet will be released as a technical note about January 1. The demand for detailed information on danger measurement has been stimulated recently by national defense area protection, now being expanded in several eastern states under deficiency appropriations.

Effects. In September, Jemison and Keetch met with Curry and Bickford of the Southern Station and members of the Region 8 office in Atlanta to coordinate methods of fire damage appraisal developed by the two stations. Arrangements were made to establish a system of appraisal to be presented to all southern state fire organizations and to the National Forests. It is believed that this system will provide, for the first time, uniform methods of evaluating damage throughout the south.

Control. Field tests of the haze cutter, described in previous reports, were initiated in Regions 1, 5, and 6 during July and August. Sixteen filters were placed on key lookout points where a thorough trial of their usefulness in fire detection was to be made during the fire season. The tests were financed by the Division of Fire Control in the Washington Office. Further trials will be made in the Eastern Coastal Plains and Piedmont regions during the coming winter, and probably in the western regions again next summer.

Byram states that the filter was not equally effective for all kinds of smoke. The visibility of about 75 percent of the observed industrial smokes, such as are given off by sawmills and factories where the smoke must pass through chimneys, was not increased by the haze cutter, and sometimes these smokes were even less visible through the haze cutter. Slowly burning refuse piles near sawmills also gave off smokes which the filter would cut out in much the same way as haze.

On actual smokes, however, it seemed to do much better. Several smokes were made visible with the haze cutter which could not be seen with the naked eye. Of 10 smokes about 7 showed up clearly in much the same way as clouds. The other 3 smokes were partially cut out and showed little if any improvement in visibility when viewed through the filter.

## FOREST FIRE PROTECTION (cont'd.)

The filter will probably be most effective for smokes coming from fuels which contain considerable green material, as do the brush fields of California. It may be least effective in dry fuels such as pine needles which contain but little green undergrowth.

### Northern Rocky Mountain

The 1941 fire season, the easiest in many years in Region One, both interfered with and aided our fire research work. The interference consisted of no fires burning long enough to permit any measurements of rate of spread. If Stickel had not, early in the season, laid out six rate-of-spread plots for intentional burning under moderate to low fire danger, this season would have been a total blank in furnishing such data. As it was, only six samples were obtained compared to some forty or fifty in 1940.

The helpful feature of this easy season is that after 11 consecutive seasons of measuring differences in fire danger factors in full sun, half shade, and full shade, the records at last include one definitely "easy" year. Started in 1931 on the clear-cut, half-cut, and full-timbered sites at Priest River, this project has uncovered relations between timber canopy density and fire weather or fire danger factors for both critical and average seasons. The effects of timber canopy during an easy season could not be determined, however, for the simple reason that from 1931 through 1940 not a single season rated "easy" at Priest River. While 1941 is not expected to rate class 2.7 or the "easiest probable" it was so near to that low average that this study can now be closed as soon as the final reports are written.

Two published articles have previously summarized the outstanding facts which were apparent early in the conduct of this study. These reports, both by Jemison, were published under the titles "The Significance of the Effect of Stand Density Upon the Weather Beneath the Canopy", Journal of Forestry, April 1934, and "Influence of Weather Factors on Moisture Content of Light Fuels in Forests of the Northern Rocky Mountains," Journal of Agricultural Research, November 15, 1935. These sites and station data were also used by Haig in his study of "Factors Controlling Initial Establishment of Western White Pine and Associated Species." In addition, the clear-cut site has served as one of the standard fire danger stations of the Kaniksu Forest since danger measurements began. This use will be continued, of course, but all other daily measurements at the half-cut and full-timber stations will be permanently discontinued on October 31 this year.

During July and August a long overdue examination was made by Gisborne of field practices in measuring fire danger and the actual

## FOREST FIRE PROTECTION (cont'd.)

use on the ground of those measurements. All ten western supervisors' offices were visited, and the danger measurement stations and methods of that forest discussed. In addition 41 ranger stations and 19 lookouts, of which 52 were standard danger stations, were visited. At each of these the August 1940 records of the station visited were compared with similar records for neighboring stations in order to uncover out-of-line practices and results. At the same time criticisms and suggestions were solicited as to how to obtain better and even more usable danger measurements. Several exceptionally valuable tips were obtained in this way. Five weeks of travel over more than 2,400 miles of mostly mountain road were required for this examination.

This method of checking the use of research results and of uncovering weaknesses in those results, hence need of additional research, is believed to be both an essential and highly profitable phase of fire research. Whether or not this is called "extension work," the fact remains that research results that are not put into practice on the ground are not paying dividends. Furthermore, just as any new process evolved in the chemical laboratory must first be tested on a larger scale in a "pilot plant" before being recommended for general commercial use, so any new method, such as the numerical measurement of fire danger, must be tested and undoubtedly can be improved by actual use on the ground. It is definitely and urgently the obligation of the research agency to follow these tests all of the way through. Mere publication alone is never an end in itself. In fact, publication previous to applied testing on a "commercial" or "use" scale too frequently constitutes a permanent record of the fact that the researcher overlooked certain essential facts.

### Pacific Northwest

Some progress was made in analyzing the second sample area used in the study of adequate fire control on private lands in the Douglas-fir region, although Matthews joined the Regional Forester's staff for two months to help with State and Private Forestry's Cooperative Forest Fire Control Project. This was a war emergency project designed to give additional fire protection to national defense industries in the Douglas-fir region. In application it resulted in placing several hundred additional trained fire guards at strategic points in the region for the duration of the fire season. Most of these men were in stand-by crews of 5 to 10 men each. Fire losses were very low and there was no interruption of defense industries.

## FOREST GENETICS

### California

Breeding. A small interspecific hybridization test, which was made by Righter and Cumming with pollen supplied by the Northeastern Forest Experiment Station, has apparently proved successful. The pollination of *Pinus monticola* x *P. strobus* yielded numerous hybrids which thus far (age 1 year) have grown almost twice as rapidly as the natural progenies of either parent.

The seeds were segregated into one-milligram weight classes, stratified, and sown in paired tests, the hybrids being paired in one test with the natural progeny of the seed-parent and in the other with the progeny of the pollen-parent. In the former test there was no difference in date of germination in favor of the hybrid, so that the hybrid's superiority, though equally great, is theoretically attributable to difference in age. In both tests the hybrids exhibited a higher germination percent and better survival. Taxonomic differences have yet to be studied.

A two year test conducted by Austin at the Institute of Forest Genetics indicates that seed grading may have great practical significance in forest nursery practices. Approximately 30,000 seeds were secured in 1938 from a single ponderosa pine seed tree in the El Dorado transect of the Sierras. These were graded through 7 screens and two sizes represented by large numbers of seed were selected for the test. The seed designated as "small" passed through screen 12 and averaged 0.085 cc in volume. The seed designated as "large" passed through screen 16 and averaged 0.14 cc in volume.

Four randomized replications of four rows each were planted with each of the two seed grades. Each row had five seed spots with ten seeds planted in each spot. As they appeared the seedlings were marked with colored rings. After 75 days each seed spot was thinned. Four methods of thinning were employed, one method used throughout each row, but the methods varied at random in different rows. The bases of selection were: (1) earliest germinating seed in the spot; (2) latest germinating seed in the spot; (3) seedling with longest epicotyl; (4) seedling with the shortest epicotyl.

Several clear cut results were evident from this test. First, large seeds produce large seedlings, the average seedling from the small seed being .78 feet tall in two years, while the average seedling from large seed was .86 feet tall. Second, early germinating seed produce larger seedlings at two years than late germinating seed; among small seed those germinating earliest produced seedlings averaging .89 feet in height, while those germinating latest produced seedlings averaging .65 feet in height, and results from the large seed were comparable. Third, those seedlings with the longest epicotyls

## FOREST GENETICS (cont'd.)

(portion above the cotyledons) at 75 days were largest at the end of two years.

As these results are in accordance with other observations it is felt that they are safe to use in practical forest nursery practice.

### Northeastern

Hybridization. The season of 1941 is the first in which any considerable success has attended the efforts at hybridization in the genus Quercus. Difficulties in previous years prompted a systematic attempt in 1941 to determine, by numerous intraspecific pollinations on several successive days, the time when the pistils of Quercus alba were receptive. The data on this point, though not analyzed at present, should be quite informative, especially when correlated with the appearance of specimens which were preserved at the time of pollination. In addition, numerous crosses between Q. alba and Q. robur resulted in a large number of fertile acorns, to the cross Q. alba (♀) x Q. robur (♂). The acorns containing hybrid embryos ripened appreciably later than those containing embryos resulting from intraspecific pollinations. This influence of the genetic make-up of the embryo on maternal tissues, termed "metaxenia," has been described in dates and apples, and is interpreted as confirming the hybridity of these acorns since the fruit of Q. robur matures later than that of Q. alba.

The hybrid acorns appear also to be larger than open-pollinated acorns on the same tree (Q. alba), a characteristic presumably inherited from the larger-fruited Q. robur. This finding, if substantiated by more extensive work, will be of practical importance for tree crops and hillculture practice where acorns are utilized as forage, for it suggests that the size of fruit of trees already established may be modified according to the genetic constitution of neighboring pollen parents. Great differences in size and shape of acorns from different trees of the same species are a common occurrence, and would allow the tree-crop grower to avail himself to some extent of the results of mass selection without having to wait for one tree-generation.

Vegetative propagation. Greenwood red maple cuttings show a differential rooting response to the three basic growth substances, indoleacetic, indolebutyric, and naphthaleneacetic acid, when given three-hour treatments with these chemicals prior to placing in outdoor propagating beds. In general, treatments with indolebutyric acid resulted in more rooting, as well as a better balanced root system. A concentration of 200 mg./l. appeared to be about optimum under the conditions of these experiments. In contrast to red maple, the use of indoleacetic acid gave better rooting with greenwood cuttings of basswood.

Pacific Northwest

The Douglas-fir heredity plantations, established in 1915-16, came up for their 5-year remeasurement this fall and Morris and Munger, with liberal help from the national forests and the CCC camps, made the diameter measurement of these five plantations. This material is now being compiled and, it is thought, will make an interesting supplement to the material published in Technical Bulletin 537, "Growth of Douglas-Fir Trees of Known Seed Source."

MENSURATION

Central States

Volume Tables. On June 17, Girard made a preliminary compilation of the data taken in May and provided needed factors for preparing tables in line with those used on the Nation-wide Survey. In July, Kellogg finished the preparation of board-foot volume tables for the following species and species-groups: beech, cottonwood, black cherry, elms (slippery and American), hemlock, hickories, maples (red, silver, sugar), oaks (pin, chestnut, swamp white) black oak, red oak, oaks (white & scarlet) pines (shortleaf, pitch and Virginia), white pine, yellowpoplar and ashes (white, green, red, blue), sycamore, black walnut, cucumber-black-gum-basswood-buckeye. In addition, cubic foot tables o.b. for rough wood were prepared for the foregoing and also for aspen, black locust and willow.

In the preparation of cubic foot tables i.b. for Ohio, the suggestion has been made to use bark factors developed elsewhere. While double bark thickness for some species groups, for example, red and black oaks and for white oaks, appear to be similar to that used by the Appalachian Survey; for others, there appear wide divergences. Progress was made toward preparing the needed cubic foot i.b. tables.

Standard volume tables were prepared for eastern hemlock, black gum and eastern white pine using the data taken by the Ohio Forest Survey.

Stand Studies, Growth and Yield. Remeasurement of some forty plots in Indiana farm woods began on June 10. These plots were established cooperatively with Purdue University in 1931 and they represent, therefore, 10 years' growth change. Prior to establishment of the plots, some of the woods had been retired from grazing for varying periods. Some have continued to be grazed, and some plots have been fenced against continued grazing in the remaining portion of the farm woods. The field work was completed by July 31.

## MENSURATION (Cont'd.)

Changes in farm woods following exclusion of livestock have been highly variable. Some woods not damaged too greatly, producing seed supply and presenting moist seedbed conditions, have produced splendid young growth. From complete openness beneath the overstory, the trend in these woods has been toward a dense stocking of valuable tolerant seedlings and saplings. Other woods display little change in the 10-year period.

Compilation of growth and of changes in basal area are in process.

Revision of the plantation black walnut manuscript is under way.

In line with suggestions for cooperative work on the growth problems of the cooperative farm forest demonstration projects, contact was made with the SCS office at Dayton on June 2, and with the demonstration project in northern Indiana on June 16. There seems to be lack of agreement on just what information is most needed.

### Northeastern

In developing regression equations for prediction of yields on spruce-fir cut-over lands, stand density was recognized as one of the important factors influencing yields. To evaluate stand density a slight modification of the method developed by Reineke was used. Using the four hundred plots which comprised the basis of the spruce cut-over land study, a table was developed showing the average number of trees per acre for different average diameters. Considering the values in the table as representing 100 percent, the density of any given stand was determined by dividing the total number of trees per acre by the total number of trees indicated in the reference table for the same diameter stand. Thus, a given stand having 704 trees per acre averaging 2.9 inches d.b.h. has a density index of 0.64, 704 divided by 1100 (number of trees indicated in the reference table below for an average diameter of 2.9 inches).

REFERENCE CURVE TABLE FOR DETERMINING STAND DENSITY FOR STRONG AND WEAK SOFTWOOD SITES

Average number of trees per acre for stands of varying average diameters as read from reference curve based on approximately 400 plots in various spruce types of the spruce-fir region of the Northeast

| D.B.H. tenths inches |       |       |       |                 |       |       |       |       |       |       |
|----------------------|-------|-------|-------|-----------------|-------|-------|-------|-------|-------|-------|
| D.B.H.<br>inches     | .0    | .1    | .2    | .3              | .4    | .5    | .6    | .7    | .8    | .9    |
|                      |       |       |       | Number of trees |       |       |       |       |       |       |
| 1                    | 1,660 | 1,625 | 1,590 | 1,560           | 1,530 | 1,500 | 1,465 | 1,435 | 1,405 | 1,375 |
| 2                    | 1,345 | 1,315 | 1,285 | 1,260           | 1,230 | 1,200 | 1,175 | 1,150 | 1,125 | 1,100 |
| 3                    | 1,075 | 1,050 | 1,025 | 1,000           | 975   | 950   | 930   | 910   | 890   | 870   |
| 4                    | 850   | 830   | 815   | 800             | 782   | 765   | 748   | 732   | 716   | 700   |
| 5                    | 685   | 670   | 655   | 640             | 625   | 610   | 595   | 582   | 569   | 555   |
| 6                    | 543   | 530   | 518   | 506             | 495   | 485   | 474   | 462   | 452   | 442   |
| 7                    | 433   | 424   | 415   | 406             | 398   | 391   | 384   | 376   | 367   | 360   |
| 8                    | 352   | 344   | 337   | 330             | 323   | 316   | 309   | 302   | 296   | 290   |
| 9                    | 283   | 276   | 269   | 263             | 257   | 251   | 246   | 240   | 235   | 230   |
| 10                   | 225   | 220   | 215   | 210             | 205   | 200   | 195   | 191   | 187   | 183   |

N.B. To determine the density of any given spruce stand, divide the total number of trees per acre by the total number of trees indicated in the above table for the same average diameter stand.

## MENSURATION (cont'd.)

Volume tables. Advantage is being taken of going logging operations and fuelwood cuttings in the vicinity of the Massabesic Experimental Forest to collect data for local board-foot volume tables for white pine and hemlock, and for cubic foot volume tables for hardwoods. The data are to be computed by Professor D. B. Demeritt at the University of Maine.

### Pacific Northwest

Growth-Immature Douglas-Fir. An analysis of trends in normality percentage in second-growth Douglas-fir stands completed during the summer represents a definite contribution from the Station's permanent sample plot project to the methodology of making growth estimates. The study has revealed, in general, that actual stands of Douglas-fir do not follow the growth trends defined by the normal yield table, but that:

1. The normality percentage of understocked stands of Douglas-fir, in general, tends to increase, that of overstocked stands to decrease with the passage of time.
2. The lower the existing normality percentage of understocked stands, the more rapid is the rate of increase in stocking; the higher the existing normality percentage in overstocked stands the more rapid is the rate of decrease in stocking.
3. Increase in normality percentage of understocked stands progresses more rapidly the younger the age class; decline in normality percentage of overstocked stands proceeds more rapidly the older the age class.
4. In young age classes normality percentage tends to increase even in stands somewhat overstocked; in advanced age classes normality percentage tends to decrease, even in stands somewhat understocked. Normal or near-normal stands do not, in general, follow the growth trends defined by the normal yield table. When young such stands tend to exceed the normal rates, but fall below these rates as age advances.
5. Trends of normality percentage in natural stands are strongly influenced by mortality. Increase in age and decrease in rate of gross growth are each accompanied by increase in mortality expressed as percent of growth.
6. Owing to the increase in mortality with age, actual technical rotations in natural stands are shorter than as computed from normal yield tables. High net yields cannot be obtained over long rotations unless the timber lost by mortality is salvaged or the loss averted by intermediate cuttings.

## MEASUREMENT (cont'd.)

Equations have been prepared from which changes in normality percentage may be readily estimated from age of stand and present stocking.

Permanent Sample Plot Remeasurements. Current reexaminations were completed of four permanent plots sampling Douglas-fir stands on the Olympic National Forest, the record for which now covers 15 years. Seven Douglas-fir plots on the Siuslaw National Forest were remeasured. Four of the latter plots were established in 1911 by T. T. Munger and E. J. Hanzlik, and now have a complete record for 30 years.

Ten red alder plots at Cascade Head Experimental Forest--the only permanent sample plots in alder in the region--were given their first remeasurement this fall.

### Southern

In the past the routine of seed testing at this station has been to germinate four 250-seed samples from each lot submitted for testing. Each sample was germinated on a peat mat, setting 25 seeds in each of ten rows. The records, which were kept separate for each row of 25 seeds, entailed a considerable amount of work. To see whether there was any justification for continuing these detailed observations a study of past records has been made.

The five sets of records analyzed to date consist of:

- (a) 17 lots of longleaf pine seed germinated in 1939-40
- (b) 22 lots of longleaf pine seed germinated in 1940-41
- (c) 25 lots of loblolly pine seed germinated in 1940-41
- (d) 16 lots of loblolly pine seed germinated in 1940-41
- (e) 12 lots of shortleaf pine seed germinated in 1940-41

If the seed used in a test was thoroughly mixed and was germinated on a homogeneous medium under uniform conditions, then the numbers of seeds germinating should be distributed according to the binomial series. Failure of the data to follow this law of distribution would indicate the presence of disturbing factors. The statistical procedure used was the Chi Square ( $\chi^2$ ) test.

$$\chi^2 = \frac{\sum \frac{(A - E)^2}{EPQ}}$$

## MENSURATION (cont'd.)

- S mean sum
- N the number of seeds per sample
- P the proportion of seeds germinating
- Q  $1-P$  the proportion of seeds not germinating
- A the actual number of seeds germinating
- E NP the estimated number of seeds germinating

First, a separate  $X^2$  was computed for each peat mat. The distribution of the individual values of  $X^2$  are shown in Table 1. For each of the five sets of records this table shows the actual and theoretical distribution of  $X^2$  for a sample with 9 degrees of freedom derived from the 10 rows of seeds per mat. The comparison of the actual and theoretical distribution can also be made by the  $X^2$  test. These values of  $X^2$  and their probabilities are shown in the last lines of the table. They indicate that the discrepancies between the actual and theoretical distributions may be attributed to chance fluctuation. However, for the a, b, and c series the data seem to be skewed toward the larger values of  $X^2$ . To test if there is a consistent bias present in the data the  $X^2$  values for each series were totaled. These values are shown in Table 2.

Table 1.

| Class interval<br>of $\chi^2$ | Probability<br>of occurrence | S e t N u m b e r |        |                  |        |                  |        |                  |        |                  |        |
|-------------------------------|------------------------------|-------------------|--------|------------------|--------|------------------|--------|------------------|--------|------------------|--------|
|                               |                              | a                 |        | b                |        | c                |        | d                |        | e                |        |
|                               |                              | Theo-<br>retical  | Actual | Theo-<br>retical | Actual | Theo-<br>retical | Actual | Theo-<br>retical | Actual | Theo-<br>retical | Actual |
| ← 2.088                       | .01                          | )                 |        | )                |        | )                |        | )                | 1)     | )                | 1)     |
| 2.089                         | .01                          | )                 |        | )                | 1)     | )                |        | )                | )      | )                | )      |
| 2.533                         | .03                          | )                 |        | )                | 4)     | )                | 10     | )                | 6      | )                | 5)     |
| 3.326                         | .05                          | )                 |        | )                |        | )                | 4      | )                | 5)     | )                | 4)     |
| 4.168                         | .10                          | )                 | 1)     |                  |        |                  | 6      |                  | 8      |                  | 2      |
| 4.169                         | .10                          | )                 | 7)     |                  |        | 10               | 5      | 6.4              | 5      | 4.8              | 7      |
| 5.381                         | .10                          |                   |        | 4.4              | 4      | 10               | 23     | 12.8             | 11     | 9.6              | 9      |
| 6.393                         | .20                          |                   | 5      | 8.8              | 4      | 10               | 23     | 12.8             | 10     | 9.6              | 9      |
| 6.394                         | .20                          | 13.6              | 13     | 17.6             | 15     | 20               | 23     | 12.8             | 8      | 4.8              | 3      |
| 8.344                         | .20                          | 13.6              | 20     | 17.6             | 17     | 20               | 13     | 6.4              | 7      | 4.8              | 9      |
| 10.657                        | .10                          | 6.8               | 8      | 8.8              | 14     | 10               | 12     | 6.4              | 6      | )                | 3)     |
| 12.243                        | .10                          | 6.8               | 4      | 8.8              | 9      | 10               | 5      | 3.2              | 3      | )                | 4)     |
| 14.685                        | .05                          | 3.4               | 4      | 4.4              | 7      |                  |        | 3.2              |        | )                |        |
| 16.920                        | .03                          | )                 | 2)     | )                | 3)     | )                | 3)     | 3.2              | 3      | )                |        |
| 19.679                        | .01                          | )                 | 6      | 4.4              | 6      | 5                | 8      | )                |        | )                |        |
| 21.666                        | .01                          | )                 | 2)     | )                | 3)     | )                | 2)     | )                |        | )                |        |
| 21.667 →                      |                              |                   |        |                  |        |                  |        |                  |        |                  |        |
| Total                         |                              | 68                | 68     | 88               | 88     | 100              | 100    | 64               | 64     | 48               | 48     |
| $\chi^2$                      |                              | 9.279             |        | 8.704            |        | 11.900           |        | 4.515            |        | 7.208            |        |
| $P(\chi^2)$                   |                              | .2 → .1           |        | .5 → .3          |        | .2 → .10         |        | .9 → .8          |        | .5 → .3          |        |

Table 2.

|                | Set Number |         |          |         |         |
|----------------|------------|---------|----------|---------|---------|
|                | a          | b       | c        | d       | e       |
| Total $X^2$    | 676.415    | 881.005 | 1052.035 | 598.677 | 439.794 |
| Normal deviate | 1.809      | 2.189   | 3.455    | .677    | .281    |
| Probability    | .035       | .014    | .0003    | .248    | .390    |

For series a, b, and c, the probability is less than .05 and it is unlikely therefore that the bias is due to chance.

In series a and d all of the seed tested was fresh, in series e the seed was stored and in series b and c both fresh and stored seed was used. The total  $X^2$  for each of the series b and c was separated into a part representing fresh seed and a part representing stored seed. The  $X^2$  obtained after this separation indicated that the abnormal variation was in the stored seed lots.

It was thought that certain lots of seed might be more available than other lots. Therefore, the  $X^2$ 's representing the four individual peat mats were totaled for each lot. The value of this statistic at the 5% level of significance was computed for 36 degrees of freedom. Using this limit of  $X^2$  it was found that 8 of the total  $X^2$  values were larger than the computed limit at the 5% level. In the series a to e, the number of sets having  $X^2$  larger than the 5% limit was 2, 2, 3, 1, and 0, respectively. If these values are rejected the total  $X^2$  values are as shown in Table 3.

Table 3.

|                | Set Number |         |         |         |         |
|----------------|------------|---------|---------|---------|---------|
|                | a          | b       | c       | d       | e       |
| Total $X^2$    | 562.169    | 766.246 | 873.540 | 547.471 | 439.794 |
| Normal deviate | .683       | 1.213   | 2.012   | .242    | .281    |
| Probability    | .248       | .113    | .022    | .405    | .390    |

Although the data are not complete enough to allow one to explain the large variation, they do indicate that except for series c and for a few tests in the other series, the variation among rows within mats is not very different from what would be expected by chance.

Using the mat as an individual observation the  $X^2$  values for each series of 4 mats was computed. The distribution of these  $X^2$  is

## MENSURATION (cont'd.)

shown in Table 4. Grouping the  $X^2$  for each of the 5 sets of data into 3 classes, i.e.,  $X^2$  smaller than 1.006,  $X^2$  from 1.006 to 4.642 and  $X^2$  larger than 4.642 and comparing the expected and observed distributions, indicates that except for set d the variation could be due to chance. Totaling the values of  $X^2$  for each set indicated that for all 5 sets there is a bias. This information related to this test is shown in the last 3 lines of Table 4.

Summarizing from the analysis of variation within mats it appears that this variation is due mainly to chance, thus indicating a fairly uniform germinating medium and fairly satisfactory control of the environment on the individual mat. The records of individual rows within mats can therefore probably be dispensed with. However, from the analysis of between-mat variation, it appears that better control of the environment of the series of 4 mats is needed. This might be attained by computing the  $X^2$  before the tests are discarded and in case abnormal variation among mats is observed by attempting to trace and correct the cause. From the standpoint of economy it may be that the changes necessary to put the tests under a state of control will be so costly that the same accuracy can be obtained by increasing the number of replications of the test. It should also be pointed out that even though a set of germination tests may be under a state of statistical control it does not mean that the general average of the germination could not be improved. It does, however, mean that for the given procedure the variations in the results are due only to chance.

## REGENERATION

### Appalachian

Spruce type. An examination of planted plots of red spruce and red pine released from briars, bracken fern, and firecherry showed that the effect of cutting the competition carried over into the second year. Release of trees planted in April, 1940, was made in early July of the same year by cutting an opening about 3-4 feet wide around each tree. In July, 1941, the competing vegetation had not yet attained its original density or that of adjoining plots which had not been released. Firecherry cut in early July had sprouted but weakly. The planted trees in the released plots had apparently made considerably more growth than those in unreleased plots although definite data will not be available until the next spring's ground examination.

The significant point is that a repetition of release the second year, even in the densest vegetation, is not necessary. It remains to be seen whether third year release will be necessary.

Table 4.

| Class interval<br>of $X^2$ | Probability | Set number       |                  |    |    |                  |     |               |      |                  |     |
|----------------------------|-------------|------------------|------------------|----|----|------------------|-----|---------------|------|------------------|-----|
|                            |             | A                |                  | B  |    | C                |     | D             |      | E                |     |
|                            |             | a                | e                | a  | e  | a                | e   | a             | e    | a                | e   |
| $\rightarrow$              | .352        | .85)             | 3.4              | 2) | 4  | 1)               | 2   | .80)          | 3.20 | .60)             | 2.4 |
| .353 - 1.005               | .15         | 2.55)            | 3.30)            | 2) | 4  | 3.90)            | 5.2 | 2.40)         | 3.20 | 1.80)            | 2   |
| 1.006 - 4.642              | .60         | 10.20            | 13.20            | 7  | 10 | 15.60            | 17  | 9.60          | 3    | 7.20             | 5   |
| 4.643 - 7.815              | .15         | 2.55)            | 3.30)            | 3) | 6) | 3.90)            | 3)  | 2.40)         | 5)   | 1.80)            | 3)  |
| 7.816 - 11.341             | .04         | .68)             | 3.4              | 2) | 6  | 1.04)            | 5.2 | .64)          | 3.2  | .48)             | 2.4 |
| 11.342 $\rightarrow$       | .01         | .17)             | .22)             | 1) | 1) | .26)             | 3)  | .16)          | 1)   | .12)             | 2)  |
| $X^2$                      |             | 3.098            | 3.757            |    |    | 2.218            |     | 15.251        |      | 3.556            |     |
| $P(X^2)$                   |             | .3 $\rightarrow$ | .2 $\rightarrow$ | .1 |    | .5 $\rightarrow$ | .3  | $\rightarrow$ | .001 | .2 $\rightarrow$ | .1  |
| Total $X^2$                |             | 68.304           | 88.129           |    |    | 91.230           |     | 79.212        |      | 55.127           |     |
| Normal deviate             |             | 1.638            | 1.830            |    |    | 2.062            |     | 2.840         |      | 2.074            |     |
| P                          |             | .050             | .034             |    |    | .020             |     | .002          |      | .019             |     |

Species adaptation. The routine examination of over 300 experimental plots planted in the spring of 1939 is about two-thirds completed. This is about half of a total of 700 plots established in 1938 and 1939 for the general purpose of gaining information relative to the adaptation of species to various old field sites. Indications are that these data will tend to substantiate the preliminary conclusions already gained from the series of plots established in 1938, and already published.

Planting trip. Minckler spent nearly a week on a trip in southwestern Virginia with representatives of the S.C.S., Virginia State Forest Service, and the Extension Service. The purpose of the trip was to inspect plantations and planting conditions in the region. It was found that, with some additions and slight changes, the general planting recommendations developed from the experimental plots in eastern Tennessee could be applied to this region.

#### Lake States

Status of Seed Manual. Although the beginning of the fiscal year saw the virtual completion of the individual species descriptions for the seed manual, it became more and more apparent that something would have to be done to reduce the tremendous bulk resulting from the inclusion of 430 species. It was the general consensus that about one-third reduction in bulk could be made if descriptions of such groups of species as the pines, spruces, oaks, and the like were written up on a generic basis. Any similarities would be presented once for the genus as a whole with individual differences brought out as far as possible in sample tabular form. This manner of presentation has been approved and final write-ups prepared for 8 genera involving 81 species.

Miss Hughey and Mr. Lindemann completed line drawings to illustrate the seed characteristics of about 25 genera, thus completing this phase of the work. Miss Hughey also made drawings of the early seedling stages of 25 species, raising the total of such drawings available to 119. Photographs of the seed were made of about 120 species for which no drawings have been made.

In addition to the work on this phase of the manual, Rudolf completed a draft of the chapter on seed source and Roe one on seed testing.

Cultivation of Plantations in North Dakota Sandhills. Mechanical cultivation has proved so successful with cottonwood plantations at our Denbigh, North Dakota branch that Stoeckeler and Manning have worked over 170 acres of plantations for mechanical cultivation in the future. With the help of heavy equipment supplied by the Prairie States Forestry Project the sod strips, originally left

## REGENERATION (cont'd.)

between the rows of trees to prevent soil blowing, have been ripped out so that they can be clean cultivated next year. All hand hoeing will thus give way to mechanical cultivation. The sod strips were apparently not necessary but have held back the growth of the planted trees.

### Northern Rocky Mountain

Direct Seeding Project to be Discontinued. Elimination of CCC advice and guidance projects struck a death blow to the direct seeding project which the Northern Rocky Mountain Station has been conducting for the last 4 years with such promising results. As this project was entirely financed from CCC funds, it will be impossible to continue the work except on a limited scale on a cooperative application project with the regional office of planting. It is especially unfortunate that the project must be terminated at this time as the Fish and Wildlife Service on July 1 assigned a junior biologist, Forrest S. Romero, to assist in solving some of the problems arising in making direct seeding practicable. Fortunately, the results from the study through 1940 are already incorporated in a manuscript prepared by C. S. Schopmeyer for publication as a circular. D. G. McKeever, who has been carrying on the work since Schopmeyer was transferred to the Intermountain Station last March, is completing examinations on all plots and rounding out the project in order that results of this year's work may also be included in Schopmeyer's manuscript.

### Pacific Northwest

Visits were paid to the Clemons Tree Farm of the Weyerhaeuser Timber Company, an area of some 130,000 acres which is being put under an intensive protection and planting program, and to the Neah Bay Indian Reservation where a considerable planting program is in effect. The Station's advice on these matters is highly prized even though we are not doing any new planting research.

Isaac and Munger were called in to advise with the West Coast Lumbermen's Association and the Weyerhaeuser Timber Company on the location of a large nursery which the former is to establish in the Douglas-fir region. Three proposed sites were visited and the Lumbermen's Association has since launched the construction of a 5-million capacity nursery on one of these sites which is on the Pacific Highway near Olympia, Washington.

## REGENERATION (cont'd.)

### Southern

Effect of temperature on germination. The need for temperature control in connection with germination tests of southern pine seed has been evident for several years. It is strikingly illustrated by tests run with longleaf pine seed in New Orleans in July, 1941. Seed germinated at laboratory air temperature was contrasted with seed germinated on an adjacent peat mat chilled with ice cubes; the temperatures on the unchilled mat remained almost entirely between 80° and 90° F., while those on the chilled mats fluctuated mostly between 60° and 75° F. The results were as follows:

| Seed lot | Winter test |          | July environment | Cumulative germination percentages at 4 to 6 day intervals |    |    |    |    |
|----------|-------------|----------|------------------|--|----|----|----|----|
|          | Germination | Duration |                  |  |    |    |    |    |
|          |             |          |                  | 5  | 10 | 15 | 20 | 25 |
|          | Percent     | Days     |                  |  |    |    |    |    |
| 1002     | 74.9        | 34       | 80° - 90° F.     | 0  | 2  | 2  | 5  | 9  |
|          |             |          | 60° - 75° F.     | 19   | 52 | 58 | 64 | 64 |
| 1007     | 68.2        | 30       | 80° - 90° F.     | 1  | 2  | 3  | 5  | 14 |
|          |             |          | 60° - 75° F.     | 15   | 30 | 33 | 42 | 48 |

Region 8 plans to construct within the present year a small seed laboratory with temperature and light control for the service testing of seed. Harrison Experimental Forest has been chosen for the location and the laboratory will be operated cooperatively by the Station and the Region.

Cone crop of southern pines. McCulley took over most of the work of the eleventh annual estimate of the cone crops of southern pines. The 1941 crops are in general a failure west of the Mississippi River, and poor through the eastern part of the southern pine region except for a few limited areas of light to fair production. Indications are that seed will be scarce, and at best expensive to collect, although both longleaf and slash pines in northeastern Florida have a better crop than in the past two or three years.

Spacing in plantations. Analysis of the 15-year reexaminations of slash and loblolly spacing plantations at Bogalusa showed larger yields in cords from 8 x 8 foot spacing than from 6 x 6 or 5 x 5 foot spacing, if only trees 6 in. d.b.h. and above were considered merchantable, but considerably better yield from the 5 x 5 foot spacing if all trees down to 5 or 4 inches were taken. Furthermore, the numbers of trees left at the different spacings upon

# REGENERATION (cont'd.)

cutting to specified diameter limits, in addition to the merchantable wood produced, indicate that for the first 15 years the 5 x 5 foot spacing makes the most nearly complete use of the productive capacity of the site. To offset this, there is an obvious need for early thinning in the 5 x 5 foot spacing, and for fairly early in the 6 x 6. In inaccessible stands, stagnation and the death of suppressed trees would presumably reduce the efficient producing power of the 5 x 5 spacing, but within reach of a pulpwood market for small trees, and especially on farms with an annual demand for pine stovewood and kindling, early and frequent thinnings should keep the production up.

The data on the two species are shown in the following table:

Table 1. Yield in cords 1/ from experimental spacing plantations, and numbers of living trees left, if all trees in and above specified d.b.h. classes were cut at 15 years

## A. SLASH PINE

| Smallest d.b.h.<br>class cut<br>(Inches) | 5 x 5          |                             | 6 x 6          |                             | 8 x 8          |                             |
|--|----------------|-----------------------------|----------------|-----------------------------|----------------|-----------------------------|
|  | Cords<br>taken | Trees<br>left <sub>2/</sub> | Cords<br>taken | Trees<br>left <sub>3/</sub> | Cords<br>taken | Trees<br>left <sub>4/</sub> |
| 4  | 26.2728        | 428                         | 22.1113        | 215                         | 17.3799        | 90                          |
| 5  | 20.9448        | 716                         | 18.7045        | 419                         | 16.1867        | 166                         |
| 6  | 11.7895        | 1035                        | 10.6033        | 733                         | 13.0017        | 296                         |
| 7  | 3.1180         | 1240                        | 3.0373         | 928                         | 7.3407         | 449                         |
| 8  | .4014          | 1287                        | .3815          | 977                         | 2.9002         | 532                         |
| 9  | .0966          | 1291                        | .0919          | 981                         | .6000          | 563                         |

## B. LOBLOLLY PINE

| Smallest d.b.h.<br>class<br>cut | 5 x 5          |                             | 6 x 6          |                             | 8 x 8          |                             |
|---------------------------------|----------------|-----------------------------|----------------|-----------------------------|----------------|-----------------------------|
|                                 | Cords<br>taken | Trees<br>left <sub>5/</sub> | Cords<br>taken | Trees<br>left <sub>6/</sub> | Cords<br>taken | Trees<br>left <sub>7/</sub> |
| 4                               | 14.83          | 603                         | 12.19          | 360                         | 10.38          | 114                         |
| 5                               | 11.95          | 916                         | 10.37          | 567                         | 9.71           | 203                         |
| 6                               | 6.23           | 1211                        | 5.88           | 828                         | 7.68           | 331                         |
| 7                               | 1.73           | 1357                        | 1.70           | 980                         | 3.71           | 485                         |
| 8                               | .33            | 1387                        | 0.12           | 1018                        | 1.03           | 552                         |
| 9                               | -              | 1392                        | -              | 1020                        | .08            | 569                         |

1/ Standard cords, rough wood 3 in. inside bark at small end.

(Tables 27 and 3, U. S. Dept. Agric. Misc. Pub. 50, 1939).

2/ Includes 50 trees 1 in. d.b.h. or less, largely suppressed.

|    |   |     |   |       |   |   |   |   |   |
|----|---|-----|---|-------|---|---|---|---|---|
| 3/ | " | 31  | " | 1 in. | " | " | " | " | " |
| 4/ | " | 10  | " | 1 in. | " | " | " | " | " |
| 5/ | " | 204 | " | 1 in. | " | " | " | " | " |
| 6/ | " | 79  | " | 1 in. | " | " | " | " | " |
| 7/ | " | 30  | " | 1 in. | " | " | " | " | " |

## REGENERATION (cont'd.)

Planting. An examination for survival and growth was made recently in a hardwood plantation established in the spring of 1937 on bottomland of the Mississippi Delta. The plantation contains 36 one-acre plots, planted with six species of hardwoods, and is a Latin square design with six replications of each species. The area was cleared and burned before planting. After planting, it was cultivated by means of growing a cultivated crop (corn) between the 6-foot rows of trees. This cultivation was practiced only part of the first growing season.

All species except cottonwood were seedlings, 6 - 12 inches tall, planted in a slit made by a grub hoe. Cuttings from native trees, 12 - 18 inches long, were used in the case of cottonwood, and planted in a hole made with a stick.

The data in the accompanying table indicate that the planting was largely a failure, except possibly in the case of sweet gum. The failure is attributed mostly to the significant factor of competition and suppression by the rank growth of blackberry, buckvine, ivy, and weeds. Almost impenetrable thickets of blackberry and buckvine, 5 to 8 feet high, make it exceedingly difficult for the slower growing hardwoods to compete. Frequently, the surviving trees are bent over by the excessive weight of vines, and although they may eventually get above such cover, poorly formed trees are likely to result.

Summary of Data Showing Survival and Growth

| Species      | Survival<br>(Percent) | Height<br>(Feet) |
|--------------|-----------------------|------------------|
| Sweet Gum    | 54.4                  | 6.9              |
| White Ash    | 31.2                  | 4.9              |
| Red Mulberry | 31.2                  | 5.5              |
| Cottonwood   | 2.5                   | 11.3             |
| White Oak    | 0.0                   | -                |
| Black Walnut | 0.0                   | -                |

It seems, from observations on this plantation and elsewhere, that cultivation or release must be extended beyond the first year if real success is to be obtained in plantings of hardwoods on most bottomland sites, especially with the slower growing species. Although cottonwood is a fast growing species, its failure in this case probably was due to poor rooting of the cuttings. Other tests with native cottonwood cuttings have demonstrated their rather eccentric rooting habits, and their inferiority to seedlings with respect to survival. In contrast, native cottonwood seedlings also planted in the spring of 1937 and followed by cultivation the first year, on a small area adjoining the main plantation, show a survival of 43 percent; the average tree has a diameter of 3.2 inches at B.H., and a height of 26.2 feet.

## SILVICULTURE

### Allegheny

Stand Improvement. The remeasurement of a series of weeding plots in northern hardwood, established in 1936 on the Kane Experimental Forest, indicates that it is possible to stimulate desirable development of selected crop trees, and that the heaviest treatment produces the greatest growth response. Re-sprouting of weed trees is not a serious problem. The clear length of the selected crop trees has not been reduced by the treatments used.

At the Lebanon Experimental Forest an extensive project is now under way to determine the possibility of extending the local range of Atlantic white-cedar to sites apparently capable of supporting this species but now occupied by interior stands. The study is focused on the following major problems:

1. The survival and growth of planted and spot-seeded cedar on soils of hardwood swamps and swamp borders as affected by the site and the treatment of overwood, brush, and ground surface.
2. The type and extent of T.S.I. work needed to favor advance cedar reproduction over competing hardwoods and to encourage the establishment of new seedlings.
3. The distance and direction of seed dispersal from individual cedar seed trees and from small stands.
4. The importance of browsing by deer on the early development of cedar.

Preliminary treatments on 35 sample plots on various parts of the Lebanon State Forest will be completed by the end of the 1942 spring planting season. The Station is indebted to the State Forest Supervisor and his staff for excellent cooperation in the line of both suggestions and material aid.

Harvest Cuttings. An 80-acre mature, evenaged stand of second growth beech and maple on Thundershower Run, Allegheny National Forest, has been selected for a study of the influence of degree of cutting on logging costs and on the subsequent survival and growth of residual trees. The stand before cutting averages 8,000 F.B.M. per acre. Residual stands of 2,000, 4,000, and 6,000 F.B.M. per acre respectively will be left on three 20-acre blocks. A fourth uncut block will serve as a check. Cutting will be carried on as a commercial operation under a regular Forest Service timber sale agreement. Results will be followed on fifteen 1/5-acre plots on each block.

## SILVICULTURE (cont'd.)

Sixty acres of old growth beech and maple timber on the Kane Experimental Forest was marked for cutting during the past summer. One section was marked to be cut on a 20-year rotation which will involve removing approximately  $1/3$  of the present merchantable volume. The rest of the stand is designed to be cut on a 5-year cycle with only those trees being removed which show little promise of remaining vigorous until the time of the next cut.

### Appalachian.

Weedings. Analyses of four years of annual records from permanent weeding plots in five mountain hardwood species showed that crown class of the selected crop tree before weeding was the best criterion for determining the need for weeding. Weeding is recommended for the checked crown classes of the following species:

|                 | <u>Dominant</u> | <u>Codominant</u> | <u>Intermediate</u> | <u>Overtopped</u> |
|-----------------|-----------------|-------------------|---------------------|-------------------|
| Sugar maple     | X               | X                 | X                   | X                 |
| White oak       |                 | X                 | X                   | X                 |
| Yellow poplar   |                 |                   | X                   | X                 |
| Cucumbertree    |                 |                   | X                   | X                 |
| Eastern red oak |                 |                   | X                   | X                 |

In general, weeding increased diameter growth of the released trees, particularly in the lower crown classes; increased height growth more or less except in the dominant crown class; and was especially beneficial in raising or maintaining the original crown class of the treated trees four years after treatment. Good or medium vigor of the released trees is important for good response to weeding, and trees of poor vigor should never be chosen as crop trees. Since heavy release was only slightly more beneficial than light release but almost twice as expensive in labor costs, light release is recommended.

Management of Experimental Forests. Field work has been completed and analysis is well under way for the inventory of the Lee Experimental Forest in Piedmont Virginia. This area of 2700 acres was turned over to the Station in 1939. The Lee Experimental Forest is fairly representative of forest conditions over a large part of the Virginia Piedmont, with young stands of pure and mixed shortleaf and Virginia pine on old fields, understocked and deteriorated stands of mixed oaks, frequently burned and fire-scarred sprout stands, and non-restocking old fields.

It is planned that half of the experimental forest be set aside as a management unit on a pilot-plant basis. The major problem is one of rehabilitation; stand improvement measures, intermediate

## SILVICULTURE (cont'd.)

and harvest cuttings will be practiced, with cost records kept of all operations. Most of the remaining area will be used for basic research, results of which will be applied on a larger scale to the management unit. A small area will be set aside for the use of co-operators.

### California

White fir topping for Christmas trees. The recently developed market for white fir Christmas trees admits a ray of hope to brighten the prospects for management of young stands of mixed species. Under special conditions young fir promises to be a profitable crop and, at the same time, its harvest may be directed to rescue sugar pines falling behind in the race for dominance.

The desirability of topping for Christmas trees comes into question because white fir often comes up through a cover of brush or pines and by the time a symmetrical section of crown is formed the fir is too large for a Christmas tree if taken entire. Also the struggle through cover and yielding to deep winter snows make the lower portions of the trunks undesirably crooked and tough to cut. As to future crops, it is not always easy for seedlings to replace the cut trees. It is natural to hope that topped firs will quickly regenerate new Christmas trees on the high stumps. Evidence to support this hope seems to be meager, hence a modicum of additional information is proffered -- some records made last month.

A Christmas tree cutting on the 1923 Miners Ditch Sale Area, Site I, in the vicinity of Stanislaus Branch, was made in 1937, in the course of which a small percentage of the trees were topped. The topped firs had been codominants but were exposed by stand improvement in 1934. They had been rejuvenated but had not reached the full stride of dominant height growth by 1937.

The tops were removed by a saw cut just above a whorl of branches at an average height of 4 feet. The diameter (i.b.) at the cut averaged  $2\frac{1}{4}$  inches. The trees were not marked for location or identity at the time of cutting and only 13 could be found in 1941. Apparently this number represented all that were topped on an area of about twenty acres. The condition of the trees at the end of the fourth growing season after treatment was as follows:

|                                |    |
|--------------------------------|----|
| Number of trees examined ..... | 13 |
| " " " alive .....              | 13 |
| " " " with dead tops .....     | 2  |

## SILVICULTURE (cont'd.)

|   |        |
|---|--------|
| New growth, average of longest shoots, feet .....     | 3.2    |
| " " range of longest shoots, feet .....               | 2 - 7  |
| Number of upward growing shoots, average .....        | 4.6    |
| " " " " " range .....                                 | 0 - 14 |
| " " " " " total .....                                 | 60     |
| Percentage of shoots that were upturned branches .... | 1.7    |
| " " " " " from new buds .....                         | 98.3   |
| " " new buds that were from stem .....                | 70     |
| " " " " " limbs .....                                 | 30     |
| Number of new Christmas trees, 1941 .....             | 0      |
| " " " " " future .....                                | ?      |

The reasons listed for failure to develop acceptable new Christmas trees were death of leaders, too many shoots with none dominant and symmetrical, and too rapid growth if one shoot dominant. Even with more time the prospect for good trees is unfavorable.

With respect to stand improvement, topping has little to recommend it. It would seem that serious consideration would be in order before topping is encouraged.

Harvest cutting - Redwood. The work of the Redwood Division during the last four months has been centered largely at the newly established Yurok Branch. Land surveys controls have been run, methods of cruising, mapping and recording as the basis for an inventory of the Experimental Forest have been worked out and the field work completed on about 100 acres with control lines established for a large additional area. Trees are cruised and mapped individually and other vegetation by groups on a 100 percent basis. The use of  $2\frac{1}{2}$  acre sampling units will provide flexibility in the establishment of experimental blocks to be used in the selective cutting experiments. Another season's field work will be required to cover a large enough area so that ranges of variability of stand structure, site and associated vegetation can be determined as the basis for a working plan for a series of harvest cutting experiments.

The headquarters building at the Yurok Branch, although not entirely completed, now provides usable office and dormitory facilities, and the clearing of stumps and logs, leveling, and construction of necessary roads is in progress.

### Central States

Seed Spotting Shortleaf Pine. In July a count was made of the shortleaf pine seedlings that developed from seed put in the ground last April in a seed spotting study. In general there was a very

## SILVICULTURE (cont'd.)

poor catch of seedlings. The late date at which the seed were placed in the ground (the latter part of April) may be responsible. The area on which the overstory trees were not removed or girdled contained the fewest seedlings. The area on which all overstory trees were removed contained the most seedlings. Pressing the seed into the cultivated soil in the spots with the foot gave better results than raking them in.

Growth Bands. The new type of growth band which has been under test this summer was checked against two dendrographs at Shaw Gardens in Missouri. Graphs showing diurnal variation in tree diameter as measured by different bands were almost identical and these were very similar, both in time and amount of change in diameter, to the continuous graphic record made by the dendrograph.

Selective Cutting. Assistant Supervisor Ed Lee from the Hoosier Forest, Ranger Harry Matthews and Chapman at the request of Mr. Milton Matter of Marion, Indiana, demonstrated selective tree marking in a tract of timber near Nashville, Indiana, belonging to Matter. Advantage will be taken of the proposed cut to initiate productive capacity studies in a well-stocked, many-aged, protected stand, an unusual set-up in this region.

Sylamore Logging and Milling Study. The report on the utilization of low-grade hardwoods together with shortleaf pine in the Ozarks completed during September points out some of the considerations necessary to allow removal of low-grade hardwood timber and at the same time improve composition of the residual stand. Existing timber-marking rules gave adequate cut and leave percentages for shortleaf pine, allowing removal of 22.2 percent of the total number of trees 10 inches and over in d.b.h. and containing about 42 percent of the sound pine volume. On the basis of modified timber marking rules adopted for the hardwoods, removal of 22.5 of the number of sound red and black oak 12 inches and over in d.b.h. was possible. This represented over 40 percent of the sound volume of these species. About 30 percent of the total number of sound post oak over 12 inches in d.b.h. representing over 52 percent of the sound volume of this species was also removed in the cut. The residual stand included thrifty pine trees of good quality, and a hardwood stand made up of scattered large trees of which a high proportion were cull, and a fairly dense understory of thrifty young hardwood growth. Yields of quality material in lumber and other products conform in general with the better log grades for pine while for hardwoods the better log grades failed to yield a comparable proportion of the higher quality products. This was due in part to the fact that the operator derived the same product from all sizes of trees. There is some evidence that pine logs over 14 inches in d.i.b. and hardwoods 16 inches and over in d.i.b. yield a greater percentage of quality products than was obtained from smaller logs. Logging damage by tractor skidding and felling ranked first and second in importance respectively as

# SILVICULTURE (cont'd.)

sources of injury to the residual stand. There was some evidence that the more desirable species, including immature shortleaf pine and white oak, suffered damage above the average through virtue of their occurring on ground chosen by tractor operators for skidding trails. Total damage from all logging activities was not excessive, averaging 2.7 percent of the number of residual immature trees and 5.4 percent of the residual trees of merchantable size.

## Lake States

Partial Cutting in Superior Jack Pine Favors Succession to Balsam. The 15-year remeasurement recently completed on the series of jack pine cutting experiments established on the Superior National Forest in 1926 brings out the fact that partial cutting in stands of this type speeds up the natural succession to balsam and other tolerant conifers. The stand is now 75 years old and is deteriorating badly, although one plot (a diameter limit cutting in which a heavy stand of near-merchantable trees was left) appears to be still gaining in volume at a good rate. The most striking feature observed during the 1941 remeasurement was the remarkable way in which an understory of balsam fir is developing (table 1). It is evident that partial cutting has benefited the balsam and other reproduction. The last plot in the table (intermediate trees left) is on a somewhat drier and more exposed site, which apparently accounts for the poorer stocking of reproduction. Many of the young balsam firs are approaching seed-bearing size, so the rate of stocking of balsam on all of the plots can be expected to accelerate during the next two or three decades.

Table 1.

| Cutting method      | Basal area         |          | Understory trees per acres |                |                |                |
|---------------------|--------------------|----------|----------------------------|----------------|----------------|----------------|
|                     | removed<br>in 1926 | Species  | . over 0.5 inch d.b.h.     |                |                |                |
|                     | Percent            |          | 1926<br>Number             | 1931<br>Number | 1936<br>Number | 1941<br>Number |
| Check               | 0                  | BF       | 0                          | 6              | 50             | 160            |
|                     |                    | 1/Spruce | 36                         | 36             | 36             | 38             |
|                     |                    | Aspen    | 0                          | 0              | 0              | 2              |
| Thin from below     | 49                 | BF       | 4                          | 12             | 76             | 210            |
|                     |                    | Spruce   | 10                         | 6              | 6              | 32             |
|                     |                    | Aspen    | 0                          | 10             | 34             | 42             |
| Thin from above     | 60                 | BF       | 8                          | 18             | 190            | 330            |
|                     |                    | Spruce   | 0                          | 0              | 0              | 32             |
|                     |                    | Aspen    | 2                          | 4              | 90             | 124            |
| Leave intermediates | 66                 | BF       | 0                          | 0              | 62             | 114            |
|                     |                    | Spruce   | 2                          | 2              | 14             | 52             |
|                     |                    | Aspen    | 0                          | 0              | 4              | 6              |

1/ Includes about equal proportions of black and white spruce.

## SILVICULTURE (cont'd.)

Regenerating Jack Pine on the Chippewa National Forest.  
Zehngraff has prepared a summary of the experiences of the Station and the Chippewa National Forest over several years in obtaining reproduction of jack pine. The report, which will be circulated to the Staff and rangers of the Chippewa, makes specific recommendations for application as follows:

1. The best time for logging is during the fall or winter.
2. Slash should be roughly piled as logging proceeds.
3. The soil should be disked and the cones (attached to the slash) scattered prior to May 15.
4. About 15 cones per milacre are necessary to insure good stocking of reproduction.
5. The following autumn, failed spots on scarified ground should be seed spotted with jack pine, and on unscarified ground should be planted with 2-1 or 2-2 red pine.
6. The slash from summer logging should be piled when the trees are felled to prevent the seeds from escaping from the cones and germinating in the autumn. The slash from summer logging should be scattered in the late autumn or the next spring.

These operations can be handled with K-V stumpage deposits.

### Northeastern

In order to provide data for a meeting of the York County, Maine, Farm Forest Products, Inc., a cooperative of white pine woodlot owners and operators, a set of plots, partially cut in 1934, was remeasured after seven years' growth. The stands were old-field pine in the 60- to 80-year age class. One area was clear-cut and the other was logged so as to remove all trees over 18 inches, two-thirds of those in the 11- to 18-inch class and about one-fifth of those in the 4- to 10-inch class, removing 60 percent of the volume and one-third the number of trees. The following data and table offer a comparison of "stripping" and partial cutting, on a per acre basis:

|                       |      | Stripping      | Partial cutting |
|-----------------------|------|----------------|-----------------|
| Volume cut            | 1934 | 25.4 M bd. ft. | 15.7 M bd. ft.  |
| Volume left           | 1934 | ---            | 11.3 M bd. ft.  |
| Volume now            | 1941 | ---            | 14.1 M bd. ft.  |
| Annual growth         |      | ---            | 400 bd. ft.     |
| Cost of producing     |      |                |                 |
| M bd. ft.             | 1934 | \$9.88         | \$8.66          |
| Net return            |      | 289.81         | 198.29          |
| Cash advantage        | 1934 | 91.52          | ---             |
| Values on ground now  |      | 0              | 178.08          |
| Considered in terms   |      |                |                 |
| of stumpage at \$4.00 | 1934 | 101.60         | 62.80           |
|                       | 1941 | 0              | 56.50           |
| Advantage             |      | ---            | 17.70           |

## PARTIAL CUTTING

Per acre

| DBH   | Before cutting 1934 |             |                    |               | After cutting 1934 |             |                   |               | Cut 1934  |              |               |           | Present stand 1941 |                    |                |  |
|-------|---------------------|-------------|--------------------|---------------|--------------------|-------------|-------------------|---------------|-----------|--------------|---------------|-----------|--------------------|--------------------|----------------|--|
|       | No. Trees           | Av. DBH in. | Basal area sq. ft. | Vol. M bd.ft. | No. Trees          | Av. DBH in. | Basal area sq.ft. | Vol. M bd.ft. | No. Trees | Basal area % | Vol. M bd.ft. | No. Trees | Av. DBH in.        | Basal area sq. ft. | Vol. M bd. ft. |  |
| 4-10  | 268                 | 7.7         | 86.566             | 9.4           | 213                | 7.7         | 67.961            | 7.4           | 55        | 21.5         | 2.0           | 135       | 8.1                | 48.877             | 3.5            |  |
| 11-18 | 107                 | 12.8        | 95.938             | 15.1          | 36                 | 11.6        | 26.372            | 3.9           | 71        | 72.5         | 11.2          | 57        | 11.9               | 44.144             | 7.6            |  |
| 19+   | 6                   | 21.4        | 14.901             | 2.5           | 0                  | --          | ---               | ---           | 6         | 100          | 2.5           | 0         | ---                | ---                | ---            |  |
| Total | 381                 | 9.7         | 197.405            | 27.0          | 249                | 8.3         | 94.333            | 11.3          | 132       | 52.2         | 15.7          | 192       | 9.4                | 93.021             | 14.1           |  |

## STRIPPING

Per acre

|       |     |      |         |      |
|-------|-----|------|---------|------|
| 4-10  | 500 | 7.0  | 133.677 | 13.5 |
| 11-18 | 64  | 13.7 | 65.167  | 10.6 |
| 19+   | 4   | 19.0 | 7.876   | 1.3  |
| Total | 568 | 8.2  | 206.720 | 25.4 |

These data and the financial comparisons were presented at the meeting which was held in a Cooperative member's woodlot being partially cut according to marking done by A. H. Nutting, Extension Forester of Maine, and M. A. Huberman of the Experiment Station.

Development of silvicultural research in white pine has progressed rapidly during the past summer, experiments having been established in release cutting, selection cutting, and improvement cutting as related to typical problem areas of the white pine type. An interesting phase of this work is the consideration of a 16-inch diameter limit as one of the partial cutting "treatments" in order to demonstrate results of what some of the more progressive New England lumbermen think of as "selective cutting."

Cutting on the release plots is being done by local men who work week-ends and off-days to get in their winter's fuel supply.

Cutting "wolf" trees. The heavy demand for even the roughest boxboard white pine logs presents the opportunity for farmers to "collect the bounty on their wolf trees". Measurements were made to illustrate the suppression of pine reproduction by the wolf tree by comparing number of seedlings, height, and diameter of young pine under the crown and away from the crown. Crown-spread measurements and tallies of the number of wolf trees per acre indicated that between 15 to 20 percent of the area of a woodlot may be occupied by such trees, which can now be removed to make way for straighter, fast-growing younger pines. A number of trees were cut and bucked up into logs and cordwood to determine the cost of removal and the damage from felling. Those wolf trees from which at least one log can be made will pay for the cost of cutting; those from which only cordwood can be made are felled at a loss. However, two wolf trees with logs will just "carry" one with only cordwood so that, in general, a farmer who does his own work can better than break even in cutting his wolf trees. Girdling is preferable where no logs can be made from the wolf trees. Considerable damage may result to the reproduction in the path of the fellings, but this is seldom over 25 percent of the seedlings.

### Northern Rocky Mountain

Light Cuttings in Mature Western White Pine Studied. A start was made during the summer of 1941 to study intensively the possibility and practicability of partial cuttings in mature western white pine stands to harvest potential mortality. Three sets of plots were established, two sets within the Deception Creek Experimental Forest and one set on Rapid Lightning Creek in the Kaniksu National Forest.

The Deception Creek plots were established on north-facing slopes in a 160-year-old stand composed mainly of a white pine overstory and a dense western hemlock understory. Here a trial was made of a very light cutting which removed only the poorest white pines in the stand, i.e., defective and poor vigor trees, and sufficient additional trees to make the operation practicable. Approximately 15 percent of the white pine volume, amounting to about 6 M feet per acre, was marked for cutting. Stumpage received for the timber cut was at the rate of \$13 per M when cash returns to the Government, brush

## SILVICULTURE (cont'd.)

disposal, and road construction costs are totaled. Each set of the Deception Creek plots consists of two plots, each marked for cutting but with only one plot actually cut and the other plot left as an uncut control. In one set the plots are approximately 15 acres in area each, and in the other set, 5 acres. All trees were tagged and detailed descriptions were made of each tree to arrive at an estimate of vigor.

The Rapid Lightning plots were established on a southerly slope in a 110-year-old stand which has a high percentage of pine. This set consists of three plots, each 5 acres in area, one with 50 percent of the white pine volume marked for cutting, one with 25 percent marked, and an uncut control with trees marked for cutting to compare with the 50 and 25 percent cuttings. On these plots the scheme has again been to cut the poorest white pines, leaving a stand of the most vigorous trees.

These plots are but the first of a number planned in the study of partial cuttings in both mature and immature stands of the white pine type. In mature stands, they hold out a real possibility for harvesting material now lost through mortality, and thus placing certain stands on a growing basis. In immature stands they offer the possibility of increasing quantity and quality of yields.

### Pacific Northwest

Douglas-Fir Region. Two Ames, Iowa senior students made a month's study of a problem which this Station has long been wishing to make. They were given suggestions and some assistance in the office, and Munger and Isaac visited their work in the field. On a Forest Service timber sale area logged over some 25 years ago leaving many conky Douglas-fir trees per acre, they made a study of the abundance and size of the reproduction in relation to the number of conky seed trees per acre. Also, they studied the mortality of these seed trees.

During the past summer 6 of the 13 groups of selective logging plots received their first 5-year examination. One area in Sitka spruce that was cut after the fifth year showed this species to be highly subject to insect injury and decay where trees received logging injury. This species also showed a tendency to develop a new set of limbs on the trunk when the crown canopy was opened up. Some areas showed a high susceptibility to insect attack during the first two years and others showed susceptibility to windfall.

Ponderosa Pine Region. Five methods-of-cutting plots on the Deschutes Forest were reexamined this spring. These five 10-acre plots were cut over early in 1937 by various types of selective

cutting, all of which involved the removal of a rather high percentage of the original merchantable volume. It is noteworthy that windfall losses have been excessively high in the four years following cutting on this area in the Deschutes "panhandle" near the edge of the desert.

During the season a differential height pruning experiment involving the removal of varying percentages of live crowns was made in a 50-year-old ponderosa pine stand on the Lookout Mountain unit. Four plots of 96 trees each were established, two in early summer at the height of the activity of *Ips oregoni*, and two in early fall when insect activity had dropped off. Each tree on each plot was given, at random, one of the following treatments: (1) Removal of dead limbs only; removal of dead limbs and (2) 25 percent, (3) 50 percent, and (4) 75 percent of the live crown.

### Rocky Mountain

Lodgepole pine management. The first contribution from the lodgepole pine harvest cutting study, started at Fraser in 1939, was made this year. It deals with the loss of advance reproduction by treatments caused by logging. The data before and after logging was obtained from a 21 percent survey which provided estimates of the total number of seedlings on each plot with an error of less than 2.5 percent.

Before cutting there were on the average 1,600 seedlings below 4.5 feet high per acre (see table below). After logging the average dropped to approximately 900 per acre which represents a loss of 43 percent of the original advance reproduction.

No consistent relationship between the volume removed from each plot and damage was found. The clear-cut plots upon which the greatest loss was expected, lost only 32 percent of the original seedlings while the 6,000 bd. ft. plots upon which the least damage was expected lost 41 percent of the original seedlings. Closer examination of the data indicated that the differences observed were not significant. This also held true after the average losses by treatments had been adjusted for variation in original stocking.

Seedlings Per Acre Before and After Cutting

|                 | Clear<br>Cut | 2000 bd.<br>ft.reserve | 4000 bd.<br>ft.reserve | 6000 bd.<br>ft.reserve | Total | Mean  |
|-----------------|--------------|------------------------|------------------------|------------------------|-------|-------|
| Before cutting  | 1,607        | 1,686                  | 2,094                  | 1,059                  | 6,446 | 1,602 |
| After cutting   | 1,088        | 907                    | 1,020                  | 628                    | 3,643 | 911   |
| Losses          | 519          | 779                    | 1,074                  | 431                    | 2,803 | 701   |
| Adjusted losses | 520          | 744                    | 847                    | 689                    |       |       |
| Percent loss    | 32           | 46                     | 51                     | 41                     | 43    |       |

Southern

In July, the office report, covering the field examination of a liberation cutting experiment in Greeley Pasture, was completed. On this 1500-acre tract of cutover land, pine reproduction was released by either cutting or girdling competing hardwoods. The 3 principal conditions represented in the experiment set up in 1933 were; (1) cutting or girdling hardwoods overtopping pine, (2) cutting or girdling all hardwoods present, and (3) an untreated check area.

Seven years after the liberation cutting was made the two treated areas had an average of 658 and 652 pines per acre compared with 294 pines per acre on the untreated check area. The 3 different treatments were located at random in the field so that each would include similar stand conditions.

The area which was treated by cutting or girdling all hardwoods increased the openings for pine reproduction, but in 7 years the stocking of pine was approximately the same as on the area given the extensive release treatment. At present, apparently the greater costs involved in clear cutting all hardwoods exceed the benefits to pine reproduction obtained in stands similar to the one represented in Greeley Pasture.

Although the original stand was chiefly longleaf pine, this species has been largely supplanted by loblolly and shortleaf reproduction on this cutover tract.

Pine Reproduction

|           | Treatment 1<br>(Extensive release)<br>(percent) | Treatment 2<br>(Hardwoods Clear Cut)<br>(percent) | Treatment 3<br>(Check)<br>(percent) |
|-----------|---|---|-------------------------------------|
| Loblolly  | 41.3  | 53.3  | 76.4                                |
| Shortleaf | 50.2  | 31.6  | 11.0                                |
| Longleaf  | 8.5   | 15.1  | 12.6                                |

Field data were obtained on the sprouting vigor of hardwoods after treatment in order to determine the effectiveness of one liberation cutting in reducing their development. The number and heights of sprouts from treated hardwoods were tallied. Released pines which were again overtopped by hardwoods were also tallied. Less than 3 percent of the released pines on the two areas were overtopped again by hardwoods within 7 years after treatment.

The maximum annual height growth of hardwood sprouts was approximately 2 feet. The average annual height growth of most sprouts, however, was one and one half feet or less.

Sprout Height Growth

| Sprout Height<br>(feet) | Hardwoods Cut<br>(percent) | Hardwoods Girdled<br>(percent) |
|-------------------------|----------------------------|--------------------------------|
|-------------------------|----------------------------|--------------------------------|

## Treatment 2 - Extensive Release

|         |      |      |
|---------|------|------|
| 0 - 5   | 38.2 | 19.6 |
| 6 - 10  | 42.2 | 53.6 |
| 11 - 15 | 19.6 | 26.8 |

## Treatment 3 - Intensive Release

|         |      |      |
|---------|------|------|
| 0 - 5   | 10.0 | 7.0  |
| 6 - 10  | 50.9 | 51.7 |
| 11 - 15 | 39.1 | 41.3 |

The sprouting vigor of hardwoods cut and hardwoods girdled is indicated in the following table. In general the smaller hardwoods were cut and the larger trees girdled. The difference in sprouting vigor in these age classes is indicated by the following data:

Number of Hardwood Sprouts per Stem

| Sprout Number | Hardwoods cut<br>(percent) | Hardwoods Girdled<br>(percent) |
|---------------|----------------------------|--------------------------------|
|---------------|----------------------------|--------------------------------|

## Treatment 2 - Extensive Release

|               |      |      |
|---------------|------|------|
| 1             | 32.5 | 6.7  |
| 2 - 5         | 51.9 | 27.6 |
| 6+            | 4.6  | 7.5  |
| Not sprouting | 11.0 | 58.2 |

## Treatment 3 - Intensive Release

|               |      |      |
|---------------|------|------|
| 1             | 37.4 | 10.2 |
| 2 - 5         | 52.6 | 37.3 |
| 6+            | 6.0  | 13.5 |
| Not sprouting | 4.0  | 39.0 |

The CCC crews which did the release work in this experiment were without previous experience in woods work. Consequently a large part of the girdling was poorly done and more than 40 percent of all trees treated by girdling completely recovered and continued to suppress the pine. These observations indicate that considerable emphasis should be directed toward the training of workmen if they are unfamiliar with the correct methods that should be used in timber stand improvement.

Stimulating Growth of Longleaf Pine Seedlings. A study was started on the Harrison Experimental Forest in April, 1938 to test various methods of stimulating early height growth of longleaf pine seedlings. A total of 128 milacre plots were established. On each of these longleaf pine seeds were sown in April, 1938. When the seedlings came up, they were thinned to a density of five seedlings per milacre. The treatments consisted of (1) spading prior to sowing the seed; (2) hoeing or scraping off the vegetation from the surface of the ground periodically; (3) burning the grass on the milacres annually; and (4) leaving the vegetation undisturbed. Some of the plots on which the ground cover received the above treatments were watered during periods of drought, on some the ground was covered with a mulch consisting of pine needles, some received an application of fertilizer (ammonium sulfate - 400 lbs. per acre) in autumn and in early spring, and some of the plots received combinations of the above treatments.

The seedlings were examined in July, 1941 when they were three years old. The results (table 1) show that the seedlings in the denuded plots were ten times as tall as those in the plots where the grass was left in the natural condition. The seedlings in the plots in which the grass was burned each year made the least growth while those in the spaded plots were twice as tall as the pine seedlings in either the burned or the rough plots.

Watering helped the seedlings only in the "rough" where they were twice the size of those without the addition of water. Fertilizing reduced the survival of the seedlings in all but the burned plots, but the height of the seedlings was increased by fertilizer in all but the spaded plots. Addition of fertilizer and water apparently resulted in an increase in the mortality especially, in the "rough" plots where 35% of the seedlings died. The growth of the seedlings in the "rough" plots was considerably reduced, while in the other plots the differences were not very marked. The high mortality and the reduction in growth of the pines in the "rough" plots was largely due to the smothering effect of the grasses. The fertilizer and the water favored the growth of the grass which completely covered up the pine seedlings.

Mulching favored the pine seedlings in the "rough" and to some extent the seedlings in the burned plots, while mulching combined with watering exerted a very favorable influence on the seedlings both in the rough and the burned plots. The seedlings in the spaded plots suffered a slight reduction in growth while that of the pines in the burned plots was slightly increased.

Mulching combined with fertilizing resulted in a considerable increase in the growth of the pines in all the plots, but survival decreased slightly. The addition of watering to the mulched fertilized plots increased markedly the growth of the pines in the "rough", but in the other plots the pines showed only a slight response.

The data obtained after the first examination of the seedlings seem to show that the removal of the ground cover is the best means of stimulating the height growth of pine seedlings. The addition of water or mulching favors the pine in the "rough" plots more than in any of the other plots.

Table 1. Summary of Treatments and Results

Age of seedlings - 3 years  
Date of examination - 7/2/41

| Treatments                 | Ground Cover    |                  |                 |                 |                  |                 |                 |                  |                 |                 |                  |                 |
|----------------------------|-----------------|------------------|-----------------|-----------------|------------------|-----------------|-----------------|------------------|-----------------|-----------------|------------------|-----------------|
|                            | Spaded          |                  |                 | Denuded         |                  |                 | Burned          |                  |                 | Rough           |                  |                 |
|                            | % Sur-<br>vival | Av.Ht.<br>Inches | % Sur-<br>vival | % Sur-<br>vival | Av.Ht.<br>Inches | % Sur-<br>vival | % Sur-<br>vival | Av.Ht.<br>Inches | % Sur-<br>vival | % Sur-<br>vival | Av.Ht.<br>Inches | % Sur-<br>vival |
| Watered                    | 100             | 3.60             | 95              | 95              | 18.47            | 100             | 100             | 1.80             | 100             | 100             | 4.50             | 100             |
| -- Fertilized              | 85              | 4.41             | 85              | 85              | 24.82            | 100             | 100             | 2.80             | 80              | 80              | 3.00             | 80              |
| Watered Fertilized         | 80              | 4.50             | 80              | 80              | 22.38            | 90              | 90              | 2.72             | 65              | 65              | 1.69             | 65              |
| -- -- Mulched              | 100             | 3.20             | 90              | 90              | 12.00            | 100             | 100             | 2.60             | 100             | 100             | 5.05             | 100             |
| Watered -- -- Mulched      | 100             | 4.70             | 95              | 95              | 20.95            | 100             | 100             | 4.60             | 90              | 90              | 8.22             | 90              |
| Fertilized Mulched         | 80              | 7.69             | 95              | 95              | 26.89            | 80              | 80              | 3.00             | 90              | 90              | 5.94             | 90              |
| Watered Fertilized Mulched | 70              | 5.50             | 100             | 100             | 21.70            | 90              | 90              | 2.66             | 95              | 95              | 4.94             | 95              |
| No treatment               | 100             | 5.08             | 95              | 95              | 22.22            | 100             | 100             | 2.02             | 100             | 100             | 2.30             | 100             |

Southwestern

Harvest Cuttings. Logging in the Fort Valley Experimental Forest during the season of 1941 has dealt with three classes of ponderosa pine stands: virgin, cut-over by Forest Service, and cut-over by private operators.

A virgin stand has been cut by the improvement selection method. This method differs from the old group selection in that it is much lighter and aims to leave a well distributed growing stock in both yellow pine and blackjack groups. It opens up both types of groups, retaining relatively small trees of good form. From 50 to 60 percent of the volume is cut, leaving a growing stock of about 5,000 board feet per acre. Minus value trees which cannot be expected to improve in value are poisoned.

In second cuttings there is really only one practical method, namely, to remove the largest stems. An area of 90 acres logged under group-selection 16 years ago is being logged a second time. About 3,000 board feet per acre is being cut, and a somewhat smaller volume retained. Removal of limby dominant blackjacks, up to 40 inches d.b.h., is leaving the groups well stocked with smaller relatively clean-boled trees. These trees are mostly in the C and D crown classes; experience has shown that this class of trees will grow when released. In marking blackjack groups for a second cut; however, one cannot escape the conclusion that the limby type of large dominant should be taken out in the first cut, instead of being left to retard the growth of smaller trees of good form. Reproduction of 1913 origin is almost complete.

Two thousand board feet per acre has been removed from a 47-year-old loggers' selection area. The first cutting took out the best yellow pines and the largest blackjacks. The remaining yellow pines were usually defective and many have gone down. Blackjacks, up to 30 inches d.b.h., supplied most of the last cut. Practically all of the area has restocked well. Although the second cut was only about half of what might be expected on a Forest Service cut-over area after an equal lapse of time, the growing stock now compares favorably with that on Forest Service areas which have been logged a second time.

Pinon Pine Project. The 1941 pinon nut crop of the principal species of pinon pine on national forests in New Mexico and Arizona will be poor, and most woodland areas will have no commercial crop at all. Poor to good crops are predicted over large portions of the Navajo Indian Reservation in northeastern Arizona and adjacent New Mexico and on the Hualapai Indian Reservation in northwestern Arizona.

Following the good crop over large areas of New Mexico in 1940, the poor crop for this year is to be expected. The same trees ordinarily do not mature cones in any quantity in successive years, and there is usually an interval of a few years between good crops in any particular locality.

Based upon reports from several field officers and also by the application of the results of research in this species over the past several years, present indications are favorable for a good crop in some localities in 1942.

Most of the data are now available for the preparation of a final distribution map of the commercial pinon nut territory in Arizona and New Mexico. It will be the first of its kind ever published.

Stand Improvement - Tree Poisoning. Study of poisoning undesirable ponderosa pine has continued on the Fort Valley Experimental Forest. A recently developed tool (Bi-monthly Report, December 1940, Page 55) has been used.

In late October and early November 1940 a large number of misshapen or extremely coarse limbed poles were poisoned following the logging of an 80-acre plot. Because the trees were dormant or nearly so, no results were apparent by the end of November. A check this spring showed that the kill was nearly 100 percent.

During July 1941 poisoning work was resumed on another area within the experimental forest which had just been logged the second time. Many of the trees were open-grown and extremely limby, a very difficult type to kill by poisoning. The holes were spaced 2 to 6 inches apart on the bole and a 15 percent solution of sodium arsenite was used, as in the fall treatment. At the end of 6 weeks very few of the more limby trees had died. Though some of the trees had larger crowns than those killed last fall, the results this year were conspicuously less successful.

A study of the distribution of bluestain (which does not attack poisoned wood) in a dead poisoned tree showed the course followed by the poison. The unstained sector of the bole above the holes becomes wider as it approaches the top of the tree. These sectors widen until they merge at a point above which all the crown is killed. This seems to explain instances in which the upper crown is killed while some of the lower limbs remain alive.

The rapidity of this merging of the areas poisoned in the bole is dependent both on the spacing of the holes and the rapidity of the diffusion of the poison in a tangential direction. Lateral diffusion is greater when the upward movement is slow, a fact which may explain the greater success during the fall and winter when transpiration is at a minimum. Further study during the fall of 1941 may lead to a recommendation of closer spacing of the holes in summer than in other seasons.

As soon as it was found that the summer poisoning had not been successful more trees were poisoned, this time at the ground level instead of the usual two feet from the ground. This practice permits greater lateral diffusion of the poison before it reaches the level of the lowest live limbs. The result was a greater number of killed trees, though still not 100 percent.

Poisoning at the ground level probably will increase the danger of poisoning nearby trees which are root-grafted. For this reason it is not recommended in dense pole stands, but only for isolated trees which are not in severe competition with others of the same age.

## FOREST PRODUCTS

### FOREST PRODUCTS STATISTICS

#### California

Lumber Census. The preliminary report of the 1940 lumber census was released in June as a Technical Note.

#### Lake States

Lumber Statistics, 1940. In connection with the lumber census conducted by the Forest Service in cooperation with the Bureau of the Census, Diemer has compiled preliminary statistics on the production of lumber, lath, and shingles in the Lake States for 1940. In each state production was up from one-fourth to one-third over that in 1939. These statistics have been issued as Technical Notes.

#### Northern Rocky Mountain

Wholesale Lumber Prices. The quarterly and annual reports on wholesale lumber selling prices, issued since 1913, have been discontinued for the present as a result of the Western Pine Association's cancelling their contract on March 31, 1941. This, together with Rapraeger's resignation, has also resulted in a discontinuance with the August issue of the Monthly Summary of Business Conditions, a report issued by this office since 1922.

## FOREST PRODUCTS STATISTICS (cont'd.)

### Pacific Northwest

Lumber Production. Forest Products Paper No. 1, which is a revision of Forest Research Notes No. 24 and brings up-to-date lumber statistics for Oregon and Washington, was prepared and distributed to interested agencies. Numerous requests have been received for additional copies.

Log Production. The 1940 log production of Oregon and Washington was compiled by States, counties, and species. Since 1937 Oregon has exceeded Washington in log production, reaching an all time peak of 5,255 million feet, log scale, in 1940. The total production for these States amounted to about 10-1/3 billion feet, log scale, in 1940. Of this, 6 billion feet was Douglas-fir and nearly 2 billion feet, ponderosa pine.

Secondary Wood-Using Industries. Over 300 wood-industry schedules for the Washington Office were filled out. Some of the contacts were made by mail, a few by trips to the companies, and many were handled by telephone. In the latter groups were all of those in Portland, Tacoma, Seattle, and Everett. We think that the telephone contact has several distinct advantages. Time is saved; one does not have to travel to the plant and then cool his heels until he can see the official with the information. Phone calls get through immediately. The officials seem to like this approach because they can dig out the information at their leisure and phone it back. Perhaps the possibilities in this method should be explored further.

During June a survey was made of the minor forest products and wood-using industry requirements in the Grays Harbor Survey Unit. This survey was a part of the economic analysis being made of this unit by several of the Station divisions. Preliminary analysis of the data has been prepared and turned over to Forest Survey for incorporation into the final report.

The secondary industries within the unit are 19 in number, and in 1940 they used 74,589,000 board feet of lumber and 17,874,000 square feet of plywood. The 71 logging operators produced 977,530,000 feet of logs in 1940; the 29 sawmills used 617,200 M feet of logs to produce 709,813 M feet of lumber; the 38 shingle plants used 88,340 M feet of logs for 1,060,077 squares of shingles; the four plywood plants used 117,262 M feet of logs in the production of 253,897 M square feet (3/8-inch basis) of plywood; two basket veneer mills used 12,745 M feet of logs; and the one pulp and paper plant required 11,535 M feet of logs.

During this investigation a number of shake mills were visited. Shake manufacture is of comparatively recent origin and offers an outlet for timber that is of little value, even for shingle bolts.

Shakes are sawed from shake boards, which come from dead standing and down timber left after logging and fires and from farm land clearing. The standard shake board is 1-1/2 inches in thickness, 6-1/2 inches wide, and 25 inches long. Boards are cut up to 2-1/4 inches thick and 32 inches long, and many are wider than 6-1/2 inches. Boards are purchased by the thousand pieces. Shakes are used both for side-walls and roofs in the California market which absorbs about 90 percent of the output.

## TIMBER HARVESTING AND CONVERSION

### California

Manufacture of smoking pipe blanks. In cooperation with the Forest Survey, the Products Division has been investigating the possibilities of the burl of manzanita and other California species for the manufacture of smoking pipes. Recently two plants have started cutting blanks from manzanita burls in the vicinity of Watsonville. Brush fields in that area containing as little as 15 to 25 percent of burl-forming manzanita are exploitable if they have not been badly burned in the past 30 years. Indications that the sandy hillside soils of this region are capable of producing burls 12 inches in diameter in 30 years raise the unique land-use question: To what extent might they be put to this use?

Blacks Mountain stand evaluation. The log grading of all trees in the 1940 and 1941 methods-of-cutting plots was completed during the summer. Detailed time studies were made of tractor yarding on the 1940 "entomology"-cutting-method plot and the standard-Forest-Service-cut plot for a comparison of logging costs under these two methods.

Redwood mill study. The redwood log grades that were developed as a result of a mill study in 1935 were checked by a study of lumber production of 154 logs at The Pacific Lumber Company, Scotia, in June. The results show that although the lumber grades were higher in all log grades than the 1935 study, the proposed 3-log grades are well suited for Humboldt County redwood stands. The f.o.b. mill lumber selling value of logs 50 inches in diameter from free hand curves are:

Log grade I, \$49.98; Log grade II, \$43.14; Log grade III, \$35.42

The standard error of the curves of value over diameter are:

Log grade I, \$5.16; Log grade II, \$5.15; Log grade III, \$4.09

## TIMBER HARVESTING AND CONVERSION (cont'd.)

Log scaling with deduction for defect is rarely practiced in the redwood industry. Commonly the Spaulding rule minus 30 percent is regarded as net. Scaling in this study was done by a man who was experienced in standard Forest Service scaling in pine, and who had done some redwood scaling, by adapting defect deductions from his pine experience. The mill tally of the entire study underruns the gross Spaulding scale by 27.8 percent. The overrun on the net scale was 4.4 percent. It is hoped that intensive study of the scale sheets will provide valuable information on redwood log defect and will contribute to more accurate scaling practice in the region. A report on this study will be completed in the near future.

Second-growth ponderosa pine mill study. The rough dry and surfaced lumber grades from 47 second-growth trees were tallied in July. The computations of this study are now in progress.

Western Sierra pine mill study. A mill study was begun in September at the mill of the Amador Lumber Company, Martell, Amador County. Both ponderosa and sugar pine are being run. The logs are graded on an 8-grade system proposed by Logging Engineer J. R. Berry, Region 5. These grades constitute a refinement of the 4-grade system now in use in this region. The external knots and other defects are being carefully charted for each log so that other log grading systems can be used in the analysis.

### Lake States

Wood Fuel and National Defense. As a part of the Station's contribution to National Defense, a statement was recently completed on the role wood can play in helping to alleviate the shortages caused by the tremendously increased use of other fuels by the national program. This is to be issued as a U. S. Department of Agriculture leaflet.

### Northern Rocky Mountain

Secondary Wood-Using Industries. In cooperation with the Washington Office, a survey was made of the secondary wood-using industries in the northern Rocky Mountain region. Don Geil, assistant agricultural aide, did the bulk of the work on this project. Wood-using industries of the region are centered chiefly in Spokane, Washington.

Mine Guides. The possibility of laminating mine guides and using them as a substitute for solid timber was briefly investigated in cooperation with the Anaconda Copper Mining Company. The company

## TIMBER HARVESTING AND CONVERSION (cont'd.)

furnished the material, which was glued in Seattle, shipped back to Missoula, and tested for strength in the University of Montana testing machine by Rapraeger and Professor J. H. Ramskill.

### Pacific Northwest

Mill Production Studies - Ponderosa Pine. Two small mill studies mentioned in the last report as conducted during May have been analyzed. Office reports, designed primarily for the information of the cooperating companies and Forest Supervisors, have been rough-drafted. These studies were conducted primarily to ascertain the reliability with which the value of the whole or a designated part of a given stand could be predicted from one-day mill studies. In both mills the value of the stand, the value of the portion marked for cutting, or the portion to be reserved were estimated from four 1-day samples with an error of plus or minus 3 to 5 percent. By using 2-day samples the error was reduced to about 2 percent. The method held forth such promise that it was deemed wise to withhold publication until additional data from two earlier and more extensive studies can be similarly analyzed. This analysis is now under way.

A work plan for a proposed Engelmann spruce mill study to be conducted by the British Columbia Forest Service and the Canadian Forest Products Laboratory at Vancouver, B. C. was prepared at the request of the Superintendent of the Laboratory. The study, which may not be made until early spring, will use the PNW 6-grade system of log grades developed for and used in the pine studies in this region.

Mill Production Studies - Douglas-Fir. An office report for the Rosboro study conducted last December and January has been completed and forwarded to the cooperating company. All cooperating agencies have also received this report with a request for their criticisms prior to publication. The formal report should be released as a Products Paper from the Station within two months.

The sales realization expectancies of the Douglas-fir logs originating on the lower slopes of the Cascades in west-central Oregon, and priced as of December 1940, ranged from \$24.05 per M feet, shipping basis, in small Grade 3 logs to \$43.35 per M feet in large Grade 1-Selected logs. Pond-marginal values (the amounts available for stump-to-pond costs, stumpage, and for profit and risk) ranged from \$4.29 per M feet, shipping basis, in small Grade 3 logs to \$25.78 per M feet in large Grade 1-Selected logs.

## TIMBER HARVESTING AND CONVERSION (cont'd.)

It was found that a formula log rule like that developed for ponderosa pine logs gave excellent results when applied to Douglas-fir. For 32-foot logs the shipping tally was expressed by the equations:

$$\text{Log}_{10} \text{ tally} = 1.8087 \log_{10} \text{ diameter} + 0.4501$$

$$\text{Correction to tally} = 3.657 \text{ diameter} - 81.491$$

Recoveries from other log lengths are proportional.

## WOOD PRESERVATION

### Northern Rocky Mountain

Practically all of the wood preservation projects were re-organized in order to simplify the job of field work, office compilation, and report preparation.

Service records for treated ponderosa pine, lodgepole pine, western larch, Douglas-fir, white fir, western hemlock, and cottonwood cross-ties, collected through inspections of three Northern Pacific test tracks on June 4 and 5, have been summarized. A formal report covering the experimental ties placed in the Thompson Falls test track, which was established in 1915 under a cooperative agreement between the Northern Pacific Railway Company and the Forest Service, has been prepared. On July 14, the butt-creosoted lodgepole pine test posts set at the Ammen Place, Missoula, in 1916 were examined. Over 70 percent of these posts were found to be in very good condition. So far none have been removed on account of decay in the treated butts. Only one post has been removed on account of top decay. It is estimated that these study posts will have an average life of 30 years or more.

In the forepart of July, Whitney prepared an article entitled, "Treating Fence Posts on the Farm," submitted to The Montana Farmer on July 18 with the understanding that it would be published a little later in the summer or in the early fall when ranchers would be planning to do maintenance work on their fences.

During the last week in July, Whitney and Geil inspected all of the main exterior boundary fences at the National Bison Range near Ravalli, Montana. This inspection covered approximately 24 miles of fence lines in which about 10,000 split and round butt-creosoted western redcedar posts were treated and set by the Forest Service when the National Bison Range was established in 1909. More than half of the original posts set at that time are still in service.

In September, the manuscript for a station paper presenting the results to date of service test studies conducted in this region by the Forest Service during the past 35 years was prepared and is now ready for final review.

### Pacific Northwest

Arsenic Paste Preservative. The scheduled biennial inspections of four Anaconda paste installations on the national forests in Washington permit tentative conclusions as to the efficacy of this preservative. These lines are in their seventh and eighth years and, with one exception, are of species not especially decay-resistant. The western redcedar line just east of Glacier, installed in August 1934, showed 83 poles sound and 17 with slight decay. The western larch line between Republic and Curlew, installed in the spring of 1934, showed 97 poles sound and 3 with slight decay. A lodgepole pine line just south of Winthrop, installed in the autumn of 1934, had 60 poles sound, 29 slightly decayed, 7 moderately decayed, and 3 with advanced decay. A Douglas-fir line near Mineral, installed in December 1933 and with only 3-1/2 pounds of paste per pole (6 lbs. is recommended), showed 62 sound poles, 25 with slight decay, 5 with moderate decay, and 8 with advanced decay.

## FOREST AND RANGE INFLUENCES

### FLOOD CONTROL SURVEYS

#### Allegheny

The Connecticut Flood Control Survey Report describes the new humus water detection theory and applies it to a flood control program. Briefly the theory is based on the fact that humus will detain for a period of approximately six days water in excess of field capacity. Humus may hold temporarily as much as 0.8 to 0.9 its volume of water of which only 0.2 to 0.3 remains when field capacity is reached. To apply this fact, the depletion of humus moisture content by seepage, transpiration, and evaporation must be calculated from the last date of saturation to determine moisture content at the beginning of a flood producing storm. When this is known, the effectiveness of various humus depths and types in taking up storm water is readily computed.

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW

### Appalachian

Modified Columbus deep-notch control installed. A modified Columbus deep-notch (CIA) weir having a 6-ft. notch within a 15-ft. flow section has been constructed on the 774-acre Bent Creek Drainage No. 4. This control is designed to give accurate discharge measurements for all flows ranging from 0.1 c.f.s. to 450 c.f.s. (4.5 ft. head on a 15-ft. flow section).

The structure is of reinforced concrete, and its design is based on the results of the latest model and prototype tests conducted at the National Hydraulics Laboratory of the Bureau of Standards. Such a sensitive and effective control is particularly adapted to small drainage areas having both extremely high and low flow stages. A bronze notch lining reduces erosion of the concrete ogee notch section to a minimum.

Twin stilling wells were constructed to compare the head on the weir as measured with (1) a perforated static tube and (2) the conventional open-end pipes perpendicular to the direction of streamflow.

Use of steep slopes for agriculture. Six acres of the 23-acre Coweeta Drainage No. 3 were planted to corn this year. The rainfall-run-off relationships had been observed over a standardization period of five years prior to the removal of the timber. Clearing operations, plowing, planting, and cultivation were handled in a manner typical of this region, since this study is designed to test the effect of present practices on water and soil resources. The cornfield has slopes ranging up to 80 percent. An estimated yield of 20 bushels per acre was obtained.

Unregulated grazing on unburned forest land. Having observed the rainfall-runoff relationships over a standardization period of 6 years for the 145-acre Coweeta Drainage No. 7, the area was fenced and 11 head of yearling-past steers and heifers from nearby farms were grazed from May 16 to August 29. This is the first season in a series of summer grazing periods on the area to determine the effect of grazing on stream behavior, soil, and vegetation.

Prior to grazing, a tally of all lesser vegetation was made on random mil-acre plots within 34 random 0.4-acre vegetation plots, 17 fenced as check plots, and 17 unfenced. Observations subsequent to grazing indicate that practically all of the drainage area had been heavily grazed. Some three-fifths of the pasture, however, contained very little palatable forage, so that while the degree of use was high, the effect on the vegetation as a whole on these areas was small.

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

Individual weights were taken periodically throughout the grazing period, showing that good gains were made until mid-July, and smaller gains thereafter.

Consumptive use of water by stream-bank vegetation. Following the usual pre-treatment standardization period, the stream-bank (riparian) vegetation was cut on the 22-acre Coweeta Drainage No. 6 during the height of the consumptive use season. Vegetation was cut along the channel within a strip whose outer boundaries lie at an elevation of 15 ft. above the channel itself. This zone includes vegetation with roots tapping the normal ground water table. The quantity of water transpired by this vegetation may be determined by analyzing and comparing runoff records before and after cutting.

Effect of removal of tree and shrub vegetation on stream behavior. Following the usual pre-treatment standardization period, all woody vegetation was removed from Coweeta Drainage Nos. 13 (40 acres) and 17 (33 acres) with minimum physical disturbance to the surface soil. The practical objective is to obtain a transpiration and evaporation factor for solution of the water economy equation for individual drainages within the region. Drainage No. 13 is expected to yield a "moving" transpiration factor, since temporary removal was effected. Sprout growth is already 10-20 ft. high on the area, 2 years after clearing. Drainage No. 17, on the other hand, cleared last winter, was sprouted back this August, and will be cut back each year, in order to ascertain the effect of permanent removal. A 100 percent cruise of this area was made prior to clearing. Paired Class "A" meteorological stations are on both areas.

### California

Precipitation. Another hydrologic season draws to a close with a total precipitation exceeding any since measurements were started on the Forest. The following table presents a picture of rainfall distribution during the season and a comparison with the average distribution for the period 1933-1941, inclusive. All of the figures are averages for the entire Forest:

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

TABLE I

| Month     | 1940-1941          |                            | Average 1933-1941  |                            |
|-----------|--------------------|----------------------------|--------------------|----------------------------|
|           | Rainfall<br>Inches | Percent of<br>season total | Rainfall<br>Inches | Percent of<br>season total |
| October   | 2.40               | 4.8                        | 1.82               | 5.6                        |
| November  | 1.68               | 3.4                        | .74                | 2.3                        |
| December  | 9.27               | 18.7                       | 7.04               | 21.7                       |
| January   | 3.57               | 7.2                        | 4.29               | 13.2                       |
| February  | 13.52              | 27.3                       | 9.04               | 27.9                       |
| March     | 12.80              | 25.8                       | 5.91               | 18.2                       |
| April     | 6.01               | 12.1                       | 2.37               | 7.3                        |
| May       | .18                | 0.4                        | .22                | 0.7                        |
| June      | .13                | 6.3                        | .11                | 0.3                        |
| July      | .00                | 0.0                        | .00                | 0.0                        |
| August    | .00                | 0.0                        | .02                | 0.1                        |
| September | .00                | 0.0                        | .88                | 2.7                        |
| Total     | 49.56              |                            | 32.44              |                            |

Runoff plots. The accompanying tables show the total runoff for the Tanbark and Fern Runoff Plot installations. The Tanbark plots have been continued with 21-year-old undisturbed chaparral cover. Most of the erosion indicated has been kicked into the troughs by rodents.

# INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

TABLE II

## TANBARK RUNOFF AND EROSION PLOTS

Summary for Season 1940 - 1941

| Plot number          | Runoff       |          |                   | Percent runoff | Erosion in pounds Oven dry weight |          |
|----------------------|--------------|----------|-------------------|----------------|-----------------------------------|----------|
|                      | Cubic feet   |          | In surface inches |                | Per plot                          | Per acre |
|                      | Per plot     | Per acre |                   |                |                                   |          |
| 321                  | 818          | 352      | 0.10              | 0.21           | 0.8                               | 32       |
| 322                  | 2.4          | 96       | .03               | .06            | 2.2                               | 88       |
| 323                  | 3.9          | 156      | .04               | .09            | .7                                | 28       |
| Subtotal             | 15.1         | 200      | 0.06              | 0.13           | 3.7                               | 49       |
| 324                  | .3           | 12       | T                 | -              | 11.8                              | 472      |
| 325                  | 1.1          | 44       | .01               | .02            | 8.0                               | 350      |
| 326                  | 2.4          | 96       | .03               | .06            | 1.1                               | 44       |
| Subtotal             | 3.8          | 51       | 0.01              | 0.02           | 20.9                              | 278      |
| 327                  | .4           | 16       | T                 | -              | 9.6                               | 384      |
| 328                  | 2.0          | 80       | .02               | .04            | 5.9                               | 236      |
| 329                  | .3           | 12       | T                 | -              | 5.5                               | 220      |
| Subtotal             | 2.7          | 36       | 0.01              | 0.02           | 21.0                              | 280      |
| Grand total          | 21.5         | 95       | 0.03              | 0.06           | 45.6                              | 202      |
| Total pre-cipitation | 46.59 inches |          |                   |                |                                   |          |

The Fern Plots have passed through their third season following their denudation in the 1938 fire. Both runoff and erosion rates have steadily lessened. A considerable amount of rodent activity has bulked the erosion on #342 and #348. On comparing the triplicate of #344, 345, and 346 with #347, 348, and 349, it is apparent that the treatment which was applied after the fire is showing its effect, as the slope of the former set is much greater than that of the latter. This treatment consisted in felling the standing trees and staking them across the slope. The latter set of plots was treated by sowing mustard the first year, but there has been no appreciable growth of mustard on them since that time.

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

TABLE III

FERN RUNOFF & EROSION  
PLOTS

Summary for season 1940-1941

| Plot number         | Runoff       |             | In<br>surface<br>inches | Per<br>cent<br>run-<br>off | Erosion in<br>pounds Oven dry<br>weight |             |
|---------------------|--------------|-------------|-------------------------|----------------------------|---|-------------|
|                     | Cubic feet   |             |                         |                            | Per<br>plot                             | Per<br>acre |
|                     | Per<br>plot  | Per<br>acre |                         |                            |   |             |
| 341                 | 23.4         | 936         | .26                     | 0.5                        | 21.6                                    | 864         |
| 342                 | 59.2         | 2368        | .66                     | 1.1                        | 36.5                                    | 1460        |
| 343                 | 68.5         | 2740        | .76                     | 1.3                        | 15.9                                    | 636         |
| Subtotal            | 151.0        | 2150        | .56                     | 1.0                        | 74.0                                    | 986         |
| 344                 | 36.1         | 1444        | .40                     | 0.7                        | 13.4                                    | 536         |
| 345                 | 27.0         | 1080        | .30                     | 0.5                        | 23.0                                    | 920         |
| 346                 | 44.1         | 1764        | .49                     | 0.8                        | 11.2                                    | 448         |
| Subtotal            | 107.2        | 1430        | .39                     | 0.7                        | 47.6                                    | 634         |
| 347                 | 29.1         | 1164        | .32                     | 0.5                        | 13.2                                    | 528         |
| 348                 | 18.8         | 752         | .21                     | 0.4                        | 31.6                                    | 1264        |
| 349                 | 45.7         | 1828        | .51                     | 0.9                        | 9.4                                     | 376         |
| Subtotal            | 93.5         | 1245        | .34                     | 0.6                        | 54.2                                    | 722         |
| Grand Total         | 351.8        | 1562        | .43                     | 0.7                        | 175.9                                   | 781         |
| Snowfall            | 21.37 inches |             |                         |                            |   |             |
| Rainfall            | 36.39        |             |                         |                            |   |             |
| Total precipitation | 57.76        |             |                         |                            |   |             |

The vegetation on the Fern Canyon SRE plots was mapped again. Table IV gives the important density figures as compared with those of earlier years. The plots were burned November 1938. The chaparral species are increasing in density, but the annuals and short-lived perennials are decreasing in importance except the two annuals Bromus tectorum and Montia perfoliata which are continuing to spread.

The mappers this year discovered that Nama parryi contains a toxic substance affecting the skin upon contact. All the mappers working on these SRE plots developed, in about three days, an acute dermatitis characterized by a general reddening and swelling of the tissue and extreme itching. In contrast to poison oak infection, there were no blisters formed. The infection was localized on the skin areas such as face and hands, which were directly in contact with the plant, and did not spread.

TABLE IV

FERN SURFICIAL RUNOFF AND EROSION PLOTS  
VEGETATION DENSITIES OF MAJOR SPECIES

(All figures in per cents)

| Cover or species                                 | 1935 | 1939 | 1940 | 1941 |
|--|------|------|------|------|
| Crown canopy                                     | 48.6 | ---  | ---  | ---  |
| Ground cover                                     | 3.1  | 11.5 | 74.7 | 69.3 |
| Litter cover                                     | 91.4 | 10.7 | 20.6 | 54.4 |
| <i>Bromus tectorum</i>                           | ---  | 0.1  | 0.6  | 1.5  |
| <i>Ceanothus integerrimus</i>                    | 0.3  | 0.2  | 0.5  | 1.8  |
| <i>Cryptantha intermedia</i>                     | ---  | 0.1  | 2.4  | 0.5  |
| <i>Garrya veatchii</i>                           | 0.2  | 0.1  | 0.1  | 0.4  |
| <i>Gilia gilioides</i>                           | ---  | 0.5  | 0.6  | 0.5  |
| <i>Lupinus longifolius</i>                       | ---  | 0.9  | 41.9 | 29.8 |
| <i>Montia perfoliata</i>                         | 0.1  | 0.1  | 0.2  | 1.6  |
| <i>Nema parryi</i>                               | ---  | 0.2  | 4.3  | 2.8  |
| <i>Phacelia brachyloba</i>                       | ---  | 9.1  | 0.8  | ---  |
| <i>Quercus chrysolepis</i>                       | 37.7 | 2.9  | 14.8 | 18.8 |
| <i>Quercus wislizenii</i> var. <i>frutescens</i> | 11.4 | 1.5  | 5.7  | 6.8  |

Intermountain

Rapid Determination of Soil Moisture. Plaster of Paris and clay blocks appear to be a promising tool for solving the problem of providing a rapid method of determining soil moisture in water utilization studies where it is essential to maintain a year-round record of water content of the soil mantle under different conditions of plant cover. The development of the mixed plaster of Paris and soil blocks has evolved through several years of study at the Intermountain Station during which the advantages and disadvantages of several alternative methods have been explored.

Tensiometers and plaster of Paris resistance blocks have been found to measure soil moisture accurately over a limited range. The tensiometers, however, are useful in moisture ranges of less than one atmosphere and frequently present difficulties due to breaks in the mercury column. Pure plaster of Paris blocks while yielding reliable measurements of medium amounts of moisture, are not accurate in either the wet or dry ranges where precise records are especially needed.

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

A resistance block containing 75 percent plaster of Paris and 25 percent clay appears to have an appreciably wider range of moisture measurement than one of pure plaster of Paris. Moreover, laboratory checks by weight show that the blocks are an accurate relative index of soil moisture throughout a wide range of moisture conditions. A field check is now under way to determine the reliability of the composition block for measuring soil moisture of natural soil profiles. These tests are being made in concrete pits which permit year-round sampling to a depth of six feet. Moisture content measurements are being made by weight but it is planned to supplement this procedure with conductivity readings with a resistance bridge. It is expected that the use of resistance blocks and conductivity readings will reduce the time of gathering soil moisture data from a matter of days to one of minutes.

### Rocky Mountain

The influence of timber cutting upon soil moisture. In September the first measurements were taken in a 4-year study of soil moisture under mature lodgepole pine. The principal object of this experiment is to determine the relative influence of timber cutting upon soil moisture deficiencies at the end of the growing season. From the viewpoint of water yield--especially from snow--the best cutting method should be that which results, on the average, in the least deficiency of soil moisture below field capacity in the autumn, shortly before the onset of winter snows.

This study, like a number of others at Fraser will play an essential role in building a well-rounded picture of forest factors influencing water yield, and especially in showing how these factors may be controlled by watershed management practices.

An interesting feature of the experiment is its attempt, by the use of biometric methods, to separate the influence of treatments from the complex of extraneous factors causing soil-moisture heterogeneity. It is a problem in sampling; each treated plot in a randomized-block design will yield a series of annual average figures on soil moisture deficiency, based on a group of samples taken each autumn, and a second group in the spring. The autumn data, taken at the end of each growing season, will represent soil moisture as depleted by the preceding season's transpiration and evaporation. These data will be subtracted from a series of data accumulated in the spring and taken at the same sites as the autumn samples just after the last snow leaves. Assuming that the spring moisture will be at approximately field capacity, the differences between the two sets of measurements should give approximate data on moisture deficiency in each of the four years of study.

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

The average for each plot will be characterized by a sampling error which may be considerable in size. Its magnitude may, however, be reduced considerably by adjustment for the influence of several concomitant variables such as the effect of surrounding or overhanging trees, seasonal precipitation and perhaps other climatic factors, and variables describing soil character. Residual, uncontrollable variation may be minimized only by the use of an adequate number of samples.

### Southwestern

Water Storage Conditions. Practically dry in July 1940 and with the irrigation land owners and operators in the Salt River Valley Water Users' Association almost reconciled to retiring considerable land from cropping, the Salt River Valley reservoir system, consisting of Roosevelt and its four auxiliary dams and Bartlett Reservoir, was full and overflowing with nearly 2 million acre-feet in storage by May 1941. Probably 85 percent of the watershed lands above this reservoir system are located within the National Forests and the White Mountain-Apache Indian Reservation.

San Carlos Reservoir, behind Coolidge Dam held over 700,000 acre-feet of water storage in June 1941, about 60 percent more than it had ever held since its construction in the late twenties. When this dam was practically dry in the spring and summer of 1940 a public controversy arose as to the ill effects of surface flow retardation and conservation methods on the upper watershed and caused the National Resources Planning Board to create a special committee that spent many months on the problem. Precipitation creating flood conditions in the Upper Gila the past few days is replenishing probably all of the winter storage which has so far been drawn this growing season. The guess that the Gila watershed controversy has been favorably settled by Nature for some time to come is not a hazardous one.

The heavy precipitation and other conditions favorable to high water yield on the Rio Grande in the spring of 1941 filled the Elephant Butte Reservoir practically to capacity--one of the few times it has been full during its existence.

Effect of grass litter on infiltration of rainfall on granitic soils in a semidesert shrub-grass area. The beneficial effects of mulches of straw and similar kinds of litter in increasing infiltration of rainfall, retarding evaporation of soil moisture, and in lessening soil erosion losses in the farming regions of midwestern United States have been stressed by many agricultural research workers. Likewise, the value of straw and grass litter as an aid in the establishment of grass and browse seedlings in the Southwest has been demonstrated. In reseeding tests conducted on the Santa Rita and Jornada Experimental Ranges in Arizona and New Mexico, Cassidy and

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

Glendening obtained better stands of grasses on areas covered with litter than on areas without litter. Bridges in similar tests made near Las Cruces, New Mexico, found marked increases in germination percentage and seedling survival in most tests where a litter mulch was used.

Measurements of the effect of grass litter on infiltration of rainfall and on soil erosion under semidesert conditions have been obtained recently in connection with lysimeter investigations which are being conducted by the Parker Creek Branch Station. These studies are on granitic soils partially depleted of grass and herb cover. The lysimeters contain large blocks of soil which were isolated by tunneling underneath a narrow tongue of soil situated between two vertical walled gullies about 6 feet in depth. Two precast slabs of concrete were placed underneath the soil above the tunnel and wedged firmly in place. The tunnel was then refilled with soil and rock which was tamped firmly into place. The slabs were placed at an inclination of approximately 10 degrees, paralleling the ground surface. After they were anchored in place and solidly supported beneath excavations for end walls and side walls were made. Concrete walls, 4 inches in thickness, were then poured to complete the two concrete boxlike tanks 3 feet wide, 5 feet long, and 3 feet in depth, which contain the undisturbed soil blocks. Side and back walls extend 3 inches above the ground surface; front wall is flush with ground level. Concrete run-off troughs to catch surface flow were added. Pipes for the collection of surface flow from the troughs and percolation flow from the front and bottom of the tanks lead to storage tanks housed in an underground pit.

At the beginning of the experiment on April 1, 1939, vegetation cover was rather sparse on both areas and about equal in density, although differing slightly as to composition. On both areas the cover, composed principally of slender grama, side-oats grama, and Wright buckwheatbrush, covered approximately 10 percent of the ground surface. During the 18 months following the initiation of the experiment only slight differences in run-off between lysimeters were recorded, ratio of run-off from lysimeter 1 to that of lysimeter 2 being only slightly larger than 1 to 1. Between April 1, 1939, and March 31, 1940, rainfall was considerably below normal and a major portion of it fell in light rains in amounts ranging from 0.10 to 0.60 inch, and surface run-off for this period was very light, no run-off at all being recorded for the winter period of 1939 - 40, as shown in the following table:

Table 1.--Effect of grass litter on infiltration and percolation of rain water and on soil erosion on granitic soils in a semidesert shrub-grass area

| Period                                      | Rainfall<br>in inches | Surface run-off<br>in inches |                    | Percolation in inches |                    | Soil erosion<br>in cubic inches |                    |
|---|-----------------------|------------------------------|--------------------|-----------------------|--------------------|---------------------------------|--------------------|
|   |                       | Lysimeter<br>No. 1           | Lysimeter<br>No. 2 | Lysimeter<br>No. 1    | Lysimeter<br>No. 2 | Lysimeter<br>No. 1              | Lysimeter<br>No. 2 |
|   |                       |                              |                    |                       |                    |                                 |                    |
| Before litter was placed on Lysimeter No. 2 |                       |                              |                    |                       |                    |                                 |                    |
| April 1 to<br>September 30, 1939            | 5.43                  | 0.42                         | 0.36               | 0                     | 0                  | 6.0                             | 11.0               |
| October 1, 1939, to<br>March 31, 1940       | 5.09                  | .22                          | .17                | 0                     | 0                  | 0                               | 0                  |
| April 1 to<br>September 30, 1940 1/         | 8.69                  | 1.13                         | 1.09               | 0                     | 0                  | 11.5                            | 18.5               |
| Total                                       | 19.21                 | 1.77                         | 1.62               | 0                     | 0                  | 17.5                            | 29.5               |
| After litter was placed on Lysimeter No. 2  |                       |                              |                    |                       |                    |                                 |                    |
| October 1, 1940, to<br>March 31, 1941       | 22.96                 | 6.06                         | 2.50               | 4.88 2/               | 7.69 2/            | 13.8                            | 7.7                |
| April 1 to<br>September 30, 1941            | 7.65                  | 1.73                         | .90                | .01                   | .10                | 44.3                            | 17.0               |
| Total                                       | 30.61                 | 7.79                         | 3.40               | 4.89                  | 7.79               | 58.1                            | 24.7               |

1/ During this period surface run-off from one storm of 1.66 inches was lost on both lysimeters when run-off pipes became clogged with erosion debris.

2/ Data on percolation, although substantially correct, are not entirely complete as storage containers overflowed during exceptionally heavy rain storms when observers were unable to reach study areas promptly, because of road washouts and other difficulties.

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (cont'd.)

Soil erosion measured during the same period amounted to 17.5 cubic inches from lysimeter No. 1, as compared to 29.5 cubic inches from lysimeter No. 2.

In October 1940 a covering of native grass litter, ranging from 1/4 to 1/2 inch in depth, was applied to the surface of one of the lysimeters, and thereafter distinct changes in run-off and erosion relationships were noted. After litter was applied, the ratio of run-off between lysimeters was approximately  $2\frac{1}{4}$  to 1, the lesser amount being recorded from No. 2, the litter-covered lysimeter. Thus the litter resulted in a greater amount of soil moisture being afforded for plant growth during the growing season. Also, increased delivery of water via the underground route during the winter of high rainfall can be attributed to the effects of the litter covering.

Application of litter also resulted in a marked decrease in soil erosion. Soil losses during the period October 1, 1940, to September 30, 1941, were greater on lysimeter No. 1, 58.1 cubic inches as against 24.7 cubic inches for No. 2, the litter-covered area.

Exceptional rainfall, more than double the normal fall, was recorded for the fall and winter period, October 1, 1940, to March 31, 1941. Early falls of this period were of fairly high intensity and large amounts of rain fell during some of the winter storms, notably during the week of March 11 to 15, when 4.48 inches fell, bringing the total fall for the period to 22.96 inches.

More effective use of rainfall can be had on semiarid range lands if grazing use is handled so as to allow for the accumulation of grass litter. Where available forage growth is utilized, very little litter will be left on the ground at the end of the grazing period. If a substantial portion of each year's growth is left standing, litter will accumulate as the unused growth is beaten to the ground by fall and winter rains. Conservative grazing use is beneficial to range and watershed vegetation in other respects, particularly in the promotion of plant vigor, by allowing the plant to maintain leafage sufficient for the production of plant food reserves. Nevertheless, litter plays an important role in forage production and soil protection. It is especially valuable on deteriorated range and watershed lands where soil moisture conservation and protection from erosion, as aids in natural reseeding, are most needed. By retarding run-off it affords greater opportunity for infiltration of rain water. It also provides insulation for ground surfaces, lessening evaporation loss of soil moisture. Litter also supplies the materials for innumerable tiny dams which hold back topsoil and seed that would otherwise be washed away.

Artificial Revegetation

Intermountain

Species

During the summer of 1941 a smut epidemic on cheatgrass (*Bromus tectorum*) occurred in Rush Valley, Utah on the Benmore experimental tract and on a much larger area in that general vicinity. Observations were made largely on land of the Central Utah Land Utilization project administered by the Soil Conservation Service.

The cheatgrass was noted to be heavily smutted, and when an automobile was driven across a field of the grass a small cloud of black dust rose behind the car. This cloud was in volume about what an automobile would stir up in a dusty field in passing over the ground at the rate of 15 to 20 miles an hour. Since heavy rain in the previous 36 hours had made the ground wet to slightly muddy, the dust was rising almost entirely from the battering of the smutted heads of cheatgrass. A rather heavy gust of wind crossed the area about 4:30 the afternoon ahead of a rainstorm moving in from the west. For a matter of 30 minutes the wind picked up smut spores until the cloud was fully as dense as that from a heavy dust storm. The smut cloud was at least 2 miles in length from east to west and a half mile or more in width. The smut rose higher into the air than a dust storm, presumably because the smut spores were lighter than the soil particles. The cloud was sooty black in shadow but was deep purple where occasional streaks of sunshine struck the edges.

The cheatgrass was so heavily smutted that the crop of yield seeds was very small, amounting to less than 10 percent of a crop and probably to only about 5 percent. It might be that the stand of cheatgrass will be greatly diminished next year or probably the year following. Smut, known as *Ustilago bromivora*, on cheatgrass makes this plant a very uncertain forage producer. The smut attacks the bromegrass family but is most virulent on cheatgrass.

When a similar epidemic of smut on cheatgrass occurred around the Arrowrock Substation on the Boise National Forest in 1933 and 1934, no previous observations were available to indicate the percentage of the infection. It is thought, however, that severe attacks occurred two years in succession. Afterward for about three years there was practically no cheatgrass on a tract of many thousands of acres. Cheatgrass increased noticeably only in the fourth year and had not by the end of the fifth year fully reoccupied the area. The forage production of cheatgrass in 1936 and 1937 was as a whole less than one percent of what it had been in 1931.

## ARTIFICIAL REVEGETATION (cont'd.)

To what extent smut will increase and hold in check this grass is not known. That the smut is common in many localities is evident from frequent reports of its occurrence. That it will reach epidemic proportions in many cases now appears to be likely. If and when this occurs, reseeding opportunities to the more valuable perennial grasses may be greatly improved by relaxation of the hold cheatgrass has on a particular site for a period of 3 to 5 years. During this time seedlings of perennial grasses would have an opportunity to establish themselves, after which under good grazing management they could probably hold their ground against cheatgrass.

### Site Factors

Insect damage to range reseeding efforts. Destructive insects have been recognized as important factors in the success of plantings of forage species for range rehabilitation. Depredations by Mormon crickets and grasshoppers are extremely common and have been responsible for numerous partial failures or at least serious retardation of development of stands on many sites in the Intermountain Region. Cricket-proof fences and grasshopper poisoning campaigns have been necessary to get a measure of species adaptability on many areas, and at the Arrowrock Substation on the Boise National Forest field trials have been unsuccessful until recent years when the cricket infestation has died out.

During the 1941 growing season, several heretofore unrecognized types of insect damage have been observed. These were all due to larvae of Coleoptera or Lepidoptera of comparatively rare species. Three instances are:

1. A 40-acre demonstration planting seeded to a mixture in the fall of 1940 near the town of Ephraim, Utah, was severely damaged by a climbing cutworm (larval form of an unidentified moth) during the early spring of 1941. On at least 70 percent of the area practically every grass seedling was killed by the worms. By chance, one small area was not infested, and seedlings of most species in the mixture made phenomenal growth on that site. On an adjacent experimental area several species of grass were eaten to the ground and many old plants of some were killed. Serious damage was also suffered on alfalfa fields and small grain plantings in the adjacent cultivated valley.

An effective control measure was found to be the commonly used bran and arsenic mash. This particular attack was too much of the nature of a blitzkrieg to permit control in time to prevent heavy losses during 1941. Farmers and experimentalists will be prepared for a second outbreak next spring.

## ARTIFICIAL REVEGETATION (cont'd.)

2. The larvae of an unusual beetle (Ludins spp.) working just under the surface of the ground cut off and destroyed many seedlings of numerous species in row tests at an elevation of 10,000 feet near the Great Basin Branch Station. Extensive damage has not occurred, but because of the insidious nature of the attack, the larvae being very difficult to find during any stage of development, it is felt that many planting failures at high elevations may be due to this cause.

3. A 1934 planting of smooth brome grass on the Davis County area that had made shoulder high growth in recent years, appeared stunted and weak in 1941. Growth amounted to only 8 to 12 inches and only a few flower stalks were produced. Close examination revealed that when the culms had made about 10 inches of growth, probably about July 10, they had been chewed off, as if by an insect. Axillary buds developed but food reserves had doubtless been heavily drawn upon to make the previous growth, and the regrowth was small and weak. Although not conclusive, the evidence points to yet another form of insect attack. Close observations will be made in 1942 in order to apprehend the offender.

## GRAZING MANAGEMENT

### Appalachian

#### Forest Grazing

Forest grazing and beef cattle survey in Georgia. The survey of forest grazing and beef cattle production in the Coastal Plain region of Georgia, started in February, has been completed. The purpose of this survey was to find exactly the use made of forest lands for cattle grazing, management practices used, results obtained in combining cattle and timber production, and what, in the opinion of the cattlemen, are the main problems in using forest lands for grazing.

On the basis of physical condition, the Coastal Plain region is usually divided into the upper Coastal Plain, the middle Coastal Plain, and the lower Coastal Plain. The data from the survey have been compiled by these divisions.

The vegetation in the three Coastal Plain divisions differs somewhat. The important forest type in the upper division is the loblolly pine-hardwood, in the middle division, the longleaf-slash pine type, and in the lower, the longleaf-slash pine-cypress type. The chief shrubs in the upper Coastal Plain are blackberries, hawthorns, and myrtle; in the middle division they are gallberries,

## GRAZING MANAGEMENT (cont'd.)

blackberries, runner oak and huckleberries; in the lower they are palmetto, gallberries, huckleberries, runner oak and myrtle. The main native forage species in the woodlands in the upper division are broomsedges, panicgrasses, and dropseeds. In the middle and lower divisions "wiregrasses", such as three-awns and muhly grasses, make up most of the forage.

Livestock laws requiring grazing animals to be fenced apply to all counties of the upper Coastal Plain division and to about one-half of those in the middle. None of the counties in the lower Coastal Plain have such laws. Counties without these laws comprise what is commonly termed "open range country."

Forest lands in the Coastal Plain region are extensively used for grazing. Based on estimates of cow-days of keep from all sources of feed through the year, the cattle on the farms surveyed receive about 65 percent of their sustenance from the forest ranges. Ninety percent of the forest land on the farms surveyed was used for grazing. Forest ranges are used mainly from about the first of April until the middle of October. However, 26 of the 106 operators interviewed keep their cattle on forest ranges yearlong.

In managing forest grazing lands, problems relating to woods burning are the most important. Practically every operator wants to avoid accidental fires, so little need be said about them. A few over half of the farmers interviewed are now practicing complete fire protection, and most of the others are doing controlled burning. A very few operators are not giving any attention to woods burning. Those practicing controlled burning give three main reasons for doing so: (1) to reduce damage and losses from devastating fires, (2) to improve the forage, and (3) to check brush.

Supplemental feeding on forest ranges has been little tested in this area. Several farmers have tried supplementing with peanut hay, grass hay, or corn shucks, and state that their results were not very good. None have tried a concentrated feed alone, such as cottonseed meal.

The practice of herd improvement has been definitely on the increase for several years. Even though this is the case, a majority of the herds are of low grade stock and much still remains to be done. Ninety-six of the operators keep the bulls with the cows yearlong.

The calf crop is very low, being about 71 percent in the upper division, 56 percent in the middle, and 40 percent in the lower. Many of the cows calve only on alternate years.

## GRAZING MANAGEMENT (cont'd.)

Based on the survey, the main problems in forest range management needing attention are:

(Not necessarily listed in order of importance)

1. Most economical wintering of winter beef cattle run primarily on forest range.
2. Extent of improvement of breeding stock.
3. Grazing capacities of various types of range and the effects of different degrees of grazing on tree growth.
4. Determination of the relative forage values of the important forage plants at all seasons.
5. Correlation of improved pastures and woodland grazing.
6. Relative values of complete fire protection of the woodlands and controlled burning.
7. If controlled burning is practiced, how often, during what months, and under what conditions it should be done.
8. Effects of periodic controlled burning on cattle gains, on brush control, and on fire hazard reduction.
9. Determination of the season when forest range can be used most effectively.
10. Increasing the calf crop.
11. Value of different systems of range management, such as deferred and rotational grazing.
12. Supplemental feeding on the range.
13. Need for mineral supplements.
14. Economics of combining cattle and timber production.

### California

Pine Ranges. An analysis of the range problems of northeastern California, which has been in preparation for nearly two years, is now receiving final editing. This analysis presents a joint effort by Administration and Research. It contains specific ideas and recommendations by Administration and the results of nearly four years of investigation by Research.

After the analysis was cleared through the local groups it was sent to Washington. Comments were received from Washington in June. Practically all of the suggestions offered were worked into the report during the following weeks, including one of illustrating the analysis with photographs.

The analysis has indicated the desirability of putting future research effort on the following problems: (1) proper season of use of cut-over pine timber and meadow types used in conjunction with one another, (2) artificial and natural revegetation of mountain meadows, and (3) life-history study of bitterbrush, the most important browse plant in northeastern California.

## GRAZING MANAGEMENT (cont'd.)

In the latter part of August a field meeting was held at the Blacks Mountain Branch for the purpose of coordinating the range-research programs of Regions 5 and 6, covering the Eastside region. Northeastern California is part of this region. Attending the meeting were: Mr. Chapline from the Washington Office; Director Wyckoff and Pickford of the Pacific Northwest Station - Region 6; and Douthitt from the Regional Office, Hansen and Lord from the Lassen Forest, and Talbot and Hormay from the California Station - Region 5. A discussion of the research programs of the two Regions showed no objectionable duplication of effort.

A detailed working plan prepared by Hormay on the season-of-use problem mentioned above, which had been previously reviewed in Washington, was discussed further at this field meeting and received Mr. Chapline's final approval. Construction of the facilities needed, including approximately 4 miles of pasture fence, a livestock corral, and water development, was started in September, therefore, but this construction cannot be completed before the spring of 1942 at the earliest.

Several field trips were made with Regional Office and Forest personnel for the purpose of viewing problems on the ground and coordinating the viewpoints of Administration and Research so that research may be carried out in the most efficient and objective manner.

Foothill Ranges. In the foothills most of the summer was spent in gathering additional information that would permit making a more efficient analysis of data already collected than has been possible in the past. This information is also essential for planning future experimentation. In analyses to date it was found necessary to try to explain certain differences in the six season-of-use pastures not due to treatment, by evaluating certain range types on the basis of soil, topography, vegetation cover, and amount of surface rock. It is hoped that this information, together with forage and livestock data collected in the pastures during the past 4 years, will better explain some of the results obtained.

Plans for the reorganization of the forage plant nursery were made and a working plan started for artificial revegetation studies.

The joint interagency manuscript, covering preliminary results of the first 5 years, obtained at the San Joaquin Experimental Range and scheduled for a University of California bulletin, is expected to reach the printer next week.

# GRAZING MANAGEMENT (cont'd.)

## Intermountain

### Spring-Fall

Arrowleaf balsamroot. Information concerning the period during which removal of herbage is most harmful to the plant is of decided value in the study of grazing systems that are desirable for the spring-fall sagebrush-grass vegetation. In the Bi-Monthly Report of February 1, 1941, page 81, some observations with respect to bluebunch wheatgrass were reported.

The following data and conclusions on arrowleaf balsamroot come as result of supplementary observations in connection with the 1940 seasonal yield study at the U. S. Sheep Experiment Station. This study consisted of six blocks, each containing 100 plants. The 100 plants in each block were clipped to the ground level. After clipping, the plants were left undisturbed for the remainder of the season. The dates of clipping corresponded to the stages of growth and development shown in tables 1 and 2.

Table 1.--Herbage production, leaf and flower stalk height at the time of clipping

| Date clipped | 1/ Herbage production air-dry (gm.) | Basal leaf height |              | Flower stalk height |              |
|--------------|-------------------------------------|-------------------|--------------|---------------------|--------------|
|              |                                     | Maximum (cm)      | Average (cm) | Maximum (cm)        | Average (cm) |
| 4/17/40      | 3.2                                 | 2.3               | 0.5          | None                | None         |
| 5/2/40       | 56.3                                | 14.7              | 10.2         | 10.3                | 8.4          |
| 5/16/40      | 145.5                               | 26.4              | 19.0         | 16.3                | 11.8         |
| 6/1/40       | 227.0                               | No data           | No data      | 27.7                | 23.4         |
| 6/19/40      | 185.5                               | 27.1              | 22.2         | 27.7                | 23.4         |

1/ Per 20 plants.

Table 2.--Developmental stages at time of clipping

| Date | Stage of development   |
|------|--|
| 4/17 | Leaves growing rapidly, flower stalks just beginning to show |
| 5/2  | Leaves growing rapidly, flower stalks and heads showing      |
| 5/16 | Leaf growth slowing down, flowers beginning to bloom         |
| 6/1  | Leaf growth ceased, blooming over                            |
| 6/19 | Plant drying, seed disseminated                              |

1/ On April 30 severe cold resulted in death of 85 percent of flower stalks.

# GRAZING MANAGEMENT (cont'd.)

Plants clipped in 1940 were left undisturbed until July, 1941. At this time flower stalks, maximum and average leaf height, and survival were recorded for each plant; in addition, for each block, similar data were secured on 20 plants unclipped in 1940. Herbage was harvested, air-dried, and weighed. These data are summarized in table 3.

Table 3.--Effect of 1940 clipping date on 1941 total herbage production, maximum and average leaf height, number of flower stalks, and plant survival.

| Date Clipped | Herbage production<br>(gm.) | Leaf height     |                 | Flower stalks<br>(cm) | Percentage survival<br>(%) |
|--------------|-----------------------------|-----------------|-----------------|-----------------------|----------------------------|
|              |                             | Maximum<br>(cm) | Average<br>(cm) |                       |                            |
| 4/17         | 177.8                       | 27.1            | 20.8            | 1.1                   | 100                        |
| 5/2          | 161.8                       | 24.9            | 19.4            | 0.2                   | 98                         |
| 5/16         | 78.3                        | 21.8            | 16.7            | 0.0                   | 85                         |
| 6/1          | 142.0                       | 24.4            | 18.6            | 0.5                   | 100                        |
| 6/19         | 166.0                       | 26.6            | 20.3            | 1.2                   | 100                        |
| Unclipped    | 191.2                       | No data         | No data         | 1.1                   | 100                        |

It may be noted from the data that for a single clipping to ground level the date most harmful to arrowleaf balsamroot was May 16. At this date leaf growth had nearly ceased, and flowers were beginning to bloom. Plants clipped on this date produced significantly less herbage than those clipped at any other date, had shorter leaves, and no flower stalks. Clipping on May 16 for only one year was fatal to 15 percent of the plants.

The next most harmful date of clipping appears to be June 1, when leaf growth had ceased and blooming was just completed. Closely following in degree of detriment was May 2, when the leaves were growing rapidly and the reproductive phase was well under way.

Clipping to ground level early in the spring season, April 17, when leaf and flower stalk growth is just starting, and clipping at the end of the spring season, June 19, after seed is disseminated and the plants are beginning to dry, differ but little in effect upon vigor of the plant the following year. Neither do plants clipped on these two dates differ by more than chance from the plants unclipped the previous year.

These data indicate that the period when total removal (100 percent utilization) is the most harmful for bluebunch wheatgrass is also the period when total removal is most harmful to arrowleaf balsamroot. This period is not near the beginning or near the end of the growing season, but near the middle of the season at a time when leaf growth has almost ceased and the chief effort appears to be reproductive.

# GRAZING MANAGEMENT (cont'd.)

If food march studies on these two species were available it might be found that the greatest harm resulted from clipping on May 16, because sufficient time or soil moisture did not remain for the production of additional foliage and other growth processes.

When plants are clipped early in the growth of the plant, sufficient moisture remains in the soil so that the plant can produce abundant foliage which will in turn manufacture foods for storage in the roots. Records from the seasonal yield series for the year 1936 to 1939, inclusive, indicate that even though 100 percent of the herbage is removed by clipping yearly in the growth of the plant substantial regrowth will be made by the end of the season (table 4).

Table 4.--Summary of herbage production during the spring season and amount of regrowth that occurred following clipping on various dates.

| Date clipped | Production on clipping date (air-dry)<br>(gm.) | Regrowth (air-dry)<br>(gm.) |
|--------------|--|-----------------------------|
| 4/30/36      | 16.0   | 185.6                       |
| 5/ 7/36      | 58.4   | 134.2                       |
| 5/13/36      | 142.7  | 52.5                        |
| 6/11/36      | 213.6  | none                        |
| 6/16/36      | 259.8  | none                        |
| 5/10/37      | 33.3   | 210.2                       |
| 5/25/37      | 188.8  | 21.7                        |
| 6/10/37      | 254.7  | none                        |
| 6/28/37      | 234.7  | none                        |
| 5/13/38      | 91.0   | 256.5                       |
| 5/27/38      | 272.8  | 50.7                        |
| 6/13/38      | 340.4  | none                        |
| 6/28/38      | 308.2  | none                        |
| 4/26/39      | 2.6  | 266.5                       |
| 5/11/39      | 127.0  | 66.2                        |
| 5/25/39      | 236.1  | 3.3                         |
| 6/10/39      | 287.0  | none                        |
| 6/26/39      | 245.7  | none                        |

There is no regrowth following clipping when removal is after June 1, owing probably to the exhaustion of soil moisture. It appears that sufficient food storage has already taken place in the roots to permit nearly normal growth the following spring.

## GRAZING MANAGEMENT (cont'd.)

### Winter Range

Range Forage Outlook for Winter Grazing. Stockmen have long awaited years when precipitation would be abundant with the hope that increased moisture would stimulate and transform weakened and dying plants into thrifty vigorous individuals. Some even talk as if grass would magically appear where there are only dead roots. At last such a year of precipitation has arrived; 1941 will doubtless be classed in the annals of the climatic records as being outstanding in both large total precipitation and favorable distribution. Precipitation for Utah and eastern Nevada was approximately 50 percent above normal for the period January 1 to July 31 this year. Western Nevada received less than normal amount of precipitation with the greatest minus departure being centered around Reno. This area received only about 60 percent of normal for January 1 to July 31. Areas in Utah around Modena and Cedar City received 160 percent of normal and Thompson recorded 256 percent of normal for the first 7 months of 1941. Plant growth responses have been varied depending on location, season, and amount of precipitation.

Growth of the forage plants on the winter ranges in western and west central Nevada is, however, far below the 1940 mark. Grasses are very short, especially the perennial species. The annual species, primarily Bromus tectorum and B. rubens, are short and the stand relatively sparse. In this district the shrubs also failed to produce much forage; the current growth is far inferior to that of 1940. The previous season's flower stalks on sagebrush and black sagebrush extend 4 to 8 inches above the current growth of the shrubs this year. This area of low forage production includes Washoe, Storey, Douglas, Lyon, Ormsby, and Mineral Counties and the western part of Humboldt, Pershing, and Churchill Counties in Nevada.

In Utah and the eastern three-quarters of Nevada forage growth on the winter ranges is much greater than average. The quantity and distribution of the precipitation has favored growth of shrubs and perennial bunchgrasses, particularly Indian ricegrass. In many places Indian ricegrass is luxuriant after exceeding 15 to 18 inches in height. This species probably shows the most outstanding forage production of any on the winter range. Shrubs such as winterfat, shadscale, and sagebrush have also made unusual growth. The current growth of these plants exceeds that of last season by 4 to 8 inches in length. Throughout northern Nevada the growth and vigor of sagebrush is almost phenomenal, having abundant vigorous leafage and flower stalks.

Peculiarly, and in spite of the unusual amount of precipitation, such species as curlygrass and grama grass did not show as great a growth response as did other plants. At the Desert Range Branch Station in western Millard County, Utah, these species have not produced any more forage than they did during the unusually dry summer of 1940. This is also true in southwestern parts of eastern Nevada.

## GRAZING MANAGEMENT (cont'd.)

Although perennial plants in general responded remarkably well to the increased moisture, yet on many ranges, particularly those where native perennial plants had been destroyed or weakened by heavy grazing, Russian-thistle is abundant and constitutes much of the ground cover. On heavily-grazed ranges in western Utah it is estimated that production by this species is more than 20 times as great as it was in 1940.

While forage production on many of the ranges is no doubt more than twice as great as in 1940, much of the so-called range improvement is more apparent than real. Few seedlings of perennial plants have become established and forage production on the heavily grazed areas is still this year less than one-quarter as much as that produced on properly grazed ranges. At the Desert Range Branch Station, areas which have been conservatively grazed produced this year from 3 to 4 times greater forage yield than did similar ranges which have been heavily grazed in recent years.

Stockmen should not be misled in their enthusiasm regarding forage yield or permanent improvement in range forage production. Precipitation as great as received this past season is unlikely to occur frequently. Ranges must, therefore, be operated under such management as will insure forage even during years of less than average precipitation.

### Northern Rocky Mountain

#### General

Rather large numbers of southern cattle, some from old Mexico, have been shipped to eastern Montana ranges again this year and sheep numbers have also increased. Restocking is proceeding at a fairly rapid but not an alarming rate, considering improved range conditions. Many stockmen now clearly recognize that experimental results from our Miles City work provides definite support for a conservative rate of stocking.

On September 23 a field day was held at the U. S. Range Livestock Experiment Station. A total of 119 persons was counted, which included a delegation of 38 from North Dakota and a lesser number from South Dakota. Heavy rains prevented a visit to experimental cattle pastures, but experimental sheep pastures and some reseeding work was visited in the afternoon after a morning session inside, during which range research results were presented, largely in graphic form. Many of the visitors expressed their interest and appreciation of the range work being done there. On September 12 a field day was held at the Vigilante Experimental Range that was attended by a smaller group of local stockmen, two county agents, and a few others who displayed keen interest in various phases.

## GRAZING MANAGEMENT (cont'd.)

### Shortgrass Range

Unusually favorable precipitation has characterized the growing season of 1941 on most Montana ranges. This is the fourth consecutive season favorable for recovery of eastern Montana ranges which in 1937 were severely depleted by several drought years. Rainfall at Miles City during August and September has been far above average and there is now an abnormal growth of green fall forage. It is now expected that experimental cows and calves at Miles City will be heavier at weaning time than during any previous year.

It is evident that there has been a substantial improvement in forage production, both at Miles City and Vigilante, as a result of four successive seasons of favorable precipitation. However, it is now evident from casual observation that the forage on heavily grazed sheep pastures at Miles City is being damaged. A recent "depletion" survey on these pastures shows that the forage stand on approximately 73 percent of the area of the heavily grazed sheep pasture is rather severely damaged. Due to unusual fall growth and close grazing, however, the yearling ewes on this small pasture have gained, up to early September, almost the same as those with more forage available.

### Methods

Cheap methods of soil preparation for reseeding of fields which support a heavy stand of downy chess, cheatgrass, are being investigated on a 10-acre area in the Bitterroot Valley. Thousands of acres of heavy cheatgrass stands occur in western Montana on which owners are reluctant to spend \$3 to \$4 per acre to plow and then pack the soil to make a good seedbed. An installation has been started where three less expensive types of soil preparation will be tested at different dates. Replicated plots have already been seeded at the early fall date with a small horsedrawn drill and will be repeated at a later fall date.

## Pacific Northwest

### General

Efforts in range research in the Pacific Northwest were divided during 1941 between management of cattle summer range, management of sheep summer range, and utilization standards. Despite the almost continuous rainfall that occurred through the summer months, the work progressed nicely, very little field time having been lost because of the inclement weather.

### Summer Range

Seasonal Use of Forage on Cattle Range. A study of the season and degree of use of forage species within three major types on the

## GRAZING MANAGEMENT (cont'd.)

Starkey Experimental Range reveals that species selectivity of cattle is marked in regard both to season and to type. For example, use of pinegrass, elk sedge and other forage species in a pinegrass type adjacent to grassland and open timber bunchgrass types was concentrated in a two-week period in August. No appreciable amount of grazing had been done before, and no grazing whatever has occurred since in this particular type. No timber-pinegrass type had been observed in which grazing was heavier than 35 percent on any species by the 20th of September, whereas grazing of bluebunch wheatgrass had reached as high as 78 percent on the same date in the open grassland types. On open grassland Sandberg's bluegrass, which makes up more than two-thirds of the grasses and almost half of the entire vegetation, was sometimes used as low as 2 and 3 percent during the same period that the excessive use of bluebunch wheatgrass occurred. This information clearly points out the difficulty of using Sandberg's bluegrass as a key species to estimate proper use of grazing allotments. It would seem that, even though the wheatgrass is present in very minor amount, its use should govern the use of the type if return to the original plant cover and resource value is an objective in the management of the grazing area.

Progressive Use of Forage by Sheep on Mountain Meadows. A meadow on the Bull Run Sheep Allotment on the Whitman Forest, grazed by a band of sheep belonging to the Eastern Oregon Agricultural Experiment Station in a cooperative range research project between the State College and the Forest Service, was selected for intensive use studies. Fifty-two permanent grazed plots were established on which the use of all forage species was determined after each day of grazing to determine the trend of selectivity in use of meadow forages and also to get some approximation of the proper degree of use of meadow types. Data collected this year were incomplete due to an accidental irregularity in handling the sheep but enough material was collected so that analysis may indicate a definite trend of use. The study will be continued next summer under better control of the livestock than was had during the past grazing season.

## Rocky Mountain

### Summer Range

Pocket gopher control study initiated. A study of the effects of pocket gophers on range vegetation was started on the Grand Mesa National Forest in August in conjunction with administration in cooperation with the Fish and Wildlife Service. The experiment station will handle the vegetation phases; the Fish and Wildlife Service will study rodent control methods and make a yearly census and record of investigations; while the Grand Mesa National Forest will furnish the records of seasonal use and numbers of livestock.

## GRAZING MANAGEMENT (cont'd.)

Four treatments are being used in the vegetation phases of the project: (1) No gophers - no cattle; (2) no gophers - cattle present; (3) gophers present - no cattle; and (4) gophers present - cattle present. Cattle are excluded from one-acre plots by means of fenced enclosures. Gophers are excluded by periodic trapping and poisoning under the supervision of the Fish and Wildlife Service. In selected areas, gophers are allowed to remain unmolested to secure treatments 3 and 4. The control methods for pocket gophers have been applied to approximately 7000 acres during the current season.

The detailed experiment is a randomized block design with each treatment replicated four times. Within the one-acre observation areas density estimates, forage weight determinations, plant vigor observations, and estimates of gopher damage due to soil movement are made randomly in 9 subdivisions. Preliminary analysis of the data indicate that the arrangement of plots and blocks is sound. Experimental error is low and differences between treatments are non-significant. Differences between large blocks are highly significant.

It is estimated that 17 percent of the total usable area of range land on the National Forests in Colorado is critically infested with rodents. Nearly 4 million acres are infested by pocket gophers alone and the range drain by these animals has been set at 872,000 animal months annually.

The objective of the present study is to determine the effects of gopher control on amount of forage and changes in vegetative composition; to ascertain the cost of eradication or control; and to study the economic feasibility of the control methods employed.

### Southwestern

#### Yearlong Range

Utilization Survey Methods. An adaptation of the line interception method for utilization surveys has been tried out during the past 3 years on the Santa Rita Experimental Range. The chief purposes of these tests were to determine:

1. Whether data suitable for use as a guide for rate of stocking and management practices could be obtained, and
2. Whether the method was sufficiently rapid and workable when used by unskilled workers as to make its use practical on large range areas.

Preliminary indications are that the method will furnish usable data not only for management purposes but also for more intensive research studies. This phase will be reported on more fully at a later date. The following information relates to the speed and workability of the method.

The 1941 utilization survey of the Santa Rita Experimental Range included the sampling of 20 separate pastures totalling more than 50,000 acres. It was accomplished under the following conditions:

1. Six men just out of the University with a fair knowledge of range plants but with no previous experience in sampling range utilization were available for a period of 11 days.
2. Trained supervision was available for the first 5 days of the 11-day period.
3. The job included a total of 351 randomly distributed sampling units, each comprised of a line 100 feet long on which the grass was to be measured and recorded by species in their respective stubble height classes.

An itemized account of the time expended is as follows: The first day was spent in getting the men into the field, equipping the three crews of two men each, and in giving instructions concerning the measurement of grass and the proper method of recording such measurements. On the second day the three crews worked in the field as a group. Each crew in turn received instructions as they measured and recorded a line while the other two crews observed. Remeasurement of several lines resulted in bringing about a reasonably consistent degree of agreement in the measurement between crews.

On the third day the crews were assigned separate pastures. Each crew, however, received some supervision during a part of the day from the third to the fifth day. From the sixth to the eleventh day the crews working alone completed an average of 18 lines representing the sampling of one pasture per day per crew. The field work was completed on the eleventh day.

In addition to the utilization data, records were taken on live and dead burroweed plants and established seedlings. Altogether, records were obtained from 35 100-foot lines totalling more than  $6\frac{1}{2}$  miles of line. A minimum of 16 lines per pasture was set; otherwise a smaller number of lines could have been used.

While this method is much more time-consuming than ocular estimates, it is believed that the results justify the time expended where accurate utilization data are needed. It also appears that for general purposes a smaller number of lines will suffice, especially where pastures or subunits are larger than those encountered on the Santa Rita.

## COOPERATING BUREAU PROJECTS

### ENTOMOLOGY

(In cooperation with the Bureau of Entomology and Plant Quarantine)

#### Appalachian

Bark beetles. During 1940, 15 areas of pine, mostly shortleaf, killed by the southern pine beetle between the spring of 1938 and the spring of 1940 on the Bent Creek Experimental Forest, were surveyed and established as plots. Recently measurements were taken on these plots to determine the volume of timber killed and the sizes of the surviving pines and living hardwoods.

A bark beetle road survey was conducted over parts of the Great Smoky Mountains National Park and the Pisgah National Forest. Only a few small groups of pines were observed to have been killed by D. frontalis in 1941.

In August an inspection was made of fire-damaged and insect-infested longleaf pine on the Francis Marion National Forest. The fire followed a drought period and the seriously weakened trees became infested with Ips engraver beetles and sawyers. These trees were to be salvaged as soon as possible. Trees likely to survive, particularly those that might serve as a seed source this fall, were reserved.

#### Northeastern

No serious defoliation by European spruce sawfly during 1941. P. B. Dowden of the New Haven, Connecticut laboratory reports as follows on the present status of the European spruce sawfly: "During 1941 there has been practically no defoliation by the European spruce sawfly (Gilpinia polytoma Htg.) in southern New Hampshire and southern Vermont. In the areas which previously were so severely defoliated, it now is difficult to find living cocoons, and on the outskirts of these areas, the infestation has remained very light. In Maine state entomologists have reported larval disease as common in the northern part of the State with a consequent reduction in infestation. In eastern Maine there has been little change from 1940 with generally light to medium infestations. In central Maine (Katahdin section) and western Maine (Rangeley section) there have been moderate increases in infestation at a number of points.

In spite of the reduction in infestation at many of the formerly severely defoliated areas, there are still a number of places where a moderate infestation persists. Many of these are in old

growth stands, notably Cornell Mt. in the Catskills of New York, Green Peak and Mt. Equinox in southern Vermont and the Scott's Bog area of Pittsburg in northern New Hampshire. The infestation at Deer Mt. in Pittsburg, N. H., on the other hand, has decreased noticeably since last year. A light infestation also persists in a number of plantations in New York state."

Severe outbreak of *Heterocampa guttivitta* (Walker) (The saddled prominent) in White Mountain region of New Hampshire. J. V. Schaffner, Jr., New Haven, Connecticut, reports on the results of a recent survey of infestations in the White Mountains of New Hampshire. During July and August reports were received from S. H. Boomer, Assistant Pathologist, Plant Disease Control, Bureau of Entomology and Plant Quarantine, located at North Conway, N. H., and V. S. Jensen, Silviculturist, U. S. Forest Service, at Bartlett, N. H., concerning severe infestations of this insect and the areas being defoliated. Through the courtesy of the White Mountain Airport officials, Mr. Boomer was able to fly over some of the mountains the first week in August to see the extent of the defoliation in that area. He estimated that some 4,000 acres of beech, maple and birch were 90 to 100 percent defoliated, and as much or more about 30 percent defoliated.

Extensive defoliated areas were located on the easterly side of North Mote up to about 2,000 feet elevation, the top and northwest side of White Horse Ledge; northerly and southerly slopes of Attitash, south side of Iron Mt., extending up to limits of the hardwoods, north side of Bartlett Haystack; patches on north side of Kearsarge and southerly side of Spruce Mt.; north and west sides of Cathedral Ledge and some on Table Mt. and Thorn Mt..

The insect passes the winter in the pupal stage in the duff beneath the trees and it is subject to heavy mortality by rodents and predacious insects, particularly *Calosoma frigidum*. Through the cooperation of the U. S. Forest Service several areas were examined in September to study the injury, to obtain data on the present status of the infestation and to collect pupae for parasitization records. It was found difficult to collect large numbers of pupae in the areas examined, partly because of the large number already destroyed. An average of 59 percent of the pupae had been destroyed by predators in each of three areas examined, while in another area 91 percent had been destroyed. In one section of a rodent burrow, not more than two feet in length, the remains of 17 pupae which had been eaten, were found.

In the areas observed where the trees were 100 percent defoliated only a very small number showed any degree of refoilation prior to September 23rd.

Proper timing of cutting operations may reduce pales weevil damage. According to S. F. Potts of the New Haven, Conn. laboratory, observations indicate that stumps of trees cut in the spring provide much more favorable food for pales weevil larvae (*Hylobius pales*) than those cut in the fall. This results in a greater larval abundance in spring-cut stumps and roots. The adults normally emerge in April and May, and in June and July lay their eggs in the most moist portions of freshly cut stumps. New adults emerge in September and October. If the trees are cut in the fall instead of in the spring, the stumps tend to dry out and become less favorable for oviposition and larval development. Therefore, cutting the trees in the fall may provide a very worthwhile means of control.

An examination was made in 1941 of stumps and roots of trees cut in 1939 and 1940. This examination showed that there were no stages of the insect remaining in stumps or roots from trees cut during 1939 or the spring of 1940. There were a few larvae in stumps cut during the fall of 1940. Examinations made in September, 1939 revealed a heavy population in stumps cut during the spring of that year.

The most severe attack of pine and Norway spruce seedlings by adults following the hurricane of September 1938 was not until the spring of 1941, which indicates that adults live more than one year. The infestation is now rapidly declining.

Matsucoccus gallicolus Morrison infestation lighter on Cape Cod, heavier in Pennsylvania. Thaddeus Parr of the New Haven, Conn. laboratory reports that a recent inspection of pitch pine areas on Cape Cod, Massachusetts, indicates that the infestation is considerably lighter than it was two years ago. The number of shoots killed on infested trees near Provincetown are about 50 percent less than was the case in 1939, and no trees were observed which had been killed by the insect during the past two years. The area infested, however, has increased during the past two years, the insect having spread westward as far as East Sandwich. The most westerly infestation by *M. gallicolus* previously noted on the north side of the Cape was at Orleans.

In Pennsylvania, however, examination of the pitch and shortleaf pine plots at Mont Alto and Mt. Union shows that the number of twigs killed was greater in 1941 than in 1940, although fewer leaders were killed in 1941 than was the case the previous year. The data on the Pennsylvania plots are summarized in the following table:

| Plot number | Species                  | Location           | Number of Current Twigs Killed |       |       |       | Number of Current leaders killed |      |      |      | Percent of Plot Trees dead |      |      |      |
|-------------|--------------------------|--------------------|--------------------------------|-------|-------|-------|----------------------------------|------|------|------|----------------------------|------|------|------|
|             |                          |                    | 1938                           | 1939  | 1940  | 1941  | 1938                             | 1939 | 1940 | 1941 | 1938                       | 1939 | 1940 | 1941 |
| I           | Pitch pine plantation    | Mont Alto, Penn.   | 2,393                          | 3,262 | 3,824 | 5,016 | 56                               | 61   | 75   | 62   | 0                          | 2.8  | 2.1  | 5.2  |
| II          | Shortleaf natural stand  | Mont Alto, Penn.   | 216                            | 316   | 564   | 640   | 20                               | 22   | 17   | 23   | 8.26                       | 7.6  | 12.8 | 15.4 |
| III         | Pitch pine plantation    | Mount Union, Penn. | 173                            | 169   | 401   | 883   | 0                                | 0    | 2    | 1    | 0                          | 0    | 0    | 0    |
| IV          | Pitch pine plantation    | Mount Union, Penn. | 939                            | 757   | 1,604 | 1,222 | 26                               | 21   | 21   | 13   | 0                          | 2.8  | 0    | 3    |
| V           | Pitch pine natural stand | Mount Union, Penn. | 1,237                          | 1,295 | 1,000 | 1,146 | 27                               | 24   | 16   | 8    | 0                          | 0    | 0    | 0    |

Southern

Habits and Control Termites. Experiments are being carried on by Johnston to determine the relative frequency of failure of the different types of metal termite shields, so that some idea may be obtained as to how often shields may fail under actual service conditions. The tests indicate that termites may probably be able, under laboratory conditions, to build tubes over any type of shield; as yet they have not built around shields of metal turned down at an angle of 90°. However, termites seldom, if ever, build tubes over shields of standard type under actual service conditions on buildings.

On July 22, an active termite tube was observed on a wooden support of a porch in full sunlight; the tube extended up on the column for a distance of 3 ft. above the ground; the house was a very old building.

Dissemination of Information to Public on Control Forest Insects, etc. Ambrosia beetles (Platypus sp.) early in July were discovered to be heavily infesting trunks and larger branches of pecan trees in Metairie (a suburb of New Orleans, Louisiana): several branches were killed and the trunks riddled. As a control contact insecticides were applied to the trunks of these infected trees. It is possible that the trees became weakened because of lack of moisture.

A chrysomelid leaf-mining beetle - Baliosus ruber (Web.) - was observed to have caused a browning of the leaves on red oak trees during July in LaSalle and Catahoula parishes in Louisiana; this same hispid beetle caused similar injury to red oak trees in Wilkinson County in Mississippi during the middle of June of this year. Evidently this is the same generation as that in Mississippi, and apparently only one generation of this beetle is produced each year.

Habits and Control Bark Beetles. Tests by Christian near Shreveport, Louisiana, have proved that the chemicals effective in protecting green hardwood logs against attack by ambrosia beetles will, as sprays, also protect pine logs against attack by Ips engraver beetles and subsequent sap stain. One part of dichlorodisphenyloxide to 5 parts of fuel oil and one part of para chlor-phenoxy-ethoxy-ethyl-chloride to 10 parts of fuel oil sprayed on freshly cut pine bolts were quite effective. However, at present the price of these chemicals is too high for their use for such a purpose.

Habits and Control Insects Attacking Forest Trees in Nurseries, Plantations, etc. Part of the week of August 25 was spent by Johnston on the Kisatchie National Forest near Alexandria, Louisiana, inspecting the results of fumigation of nests of the Texas leaf-cutting ant during hot weather with methyl bromide and trichlorobenzene; neither chemical proved effective during hot weather. An article has been prepared on these recent tests for publication in the Planting Quarterly. Methyl bromide will probably replace carbon disulphid in control operations before planting by the Federal Forest Service.

## PATHOLOGY

(In cooperation with the Bureau of Plant Industry)

### Appalachian

Little-leaf. During the summer months permanent study plots in affected and healthy pine stands were established in North Carolina and Virginia within most of the severely affected sections, and in several normal areas. The range of the disease remains from central Virginia, east and south of the mountains to northeastern Mississippi, with an occasional small area in Tennessee. Soil amendment trials established this past spring have so far indicated some favorable response of little-leaf trees to the addition of nitrogen. A large number of other chemical fertilizers, including some minor elements, have yielded no response as yet. An extensive series of grafts from diseased to healthy trees has been made to test the possibility that little-leaf is a virus disease. No results are available yet on this phase. The poor condition of the roots of diseased trees has been studied further, and plans formulated for feeding carbohydrates to little-leaf trees. Further evidence indicates a correlation of little-leaf with certain soils. Analysis of weather records has failed to reveal a correlation of little-leaf with weather. Apparatus for providing a continuous record of soil moisture in two little-leaf and nearby healthy stands has been installed. Analyses have been made of the moisture content of trunk and leaves of diseased and healthy trees, moisture content and chemical constituents of the foliage of both types of trees, and the resin content of both types. The second progress report on the little-leaf investigations will be issued about December 1, and will discuss in further detail, the progress of the past year.

Mimosa wilt. In 1940 tests were made of resistance to the wilt of 492 seedlings from 44 different seed sources. All but 38 of these died of the wilt by the end of the summer of 1940, and the 38 remaining seedlings were reinoculated in the spring of 1941 and by the end of the summer, 6 of these trees had died of the wilt. Thus 32 trees have withstood heavy inoculation two years in succession without showing symptoms of wilt. In 1942 these trees will be planted in the field in an area in which the disease is very prevalent. Additional seedlings from 4 of the most promising seed sources, from the standpoint of wilt resistance, on the basis of the 1940 trials, were inoculated in 1941. Thirty-two trees from each source were inoculated. The percentages wilted at the end of this summer were 7, 41, 60, and 88. There is thus additional evidence of resistance among some seed lots.

Plantation disease study. The first reexamination of the nineteen 50-tree plots established in 1940 in newly-planted areas has been made. These included 8 shortleaf pine plots and 11 loblolly plots. Diseases have had only minor effects so far in the plantations. There have been traces of leaf spots, leaf rust, and a fair amount of tip-moth damage in some plots. Poor planting has been responsible for

## PATHOLOGY (cont'd.)

some losses, and in the case of some deep sands of low fertility and poor water-holding capacity there has been considerable mortality in the 1 year since planting. Site factors of soil consistence, drainage, and fertility have had marked effects on growth. The originally larger seedlings have made the best growth. The growth of loblolly has exceeded that of shortleaf on comparable sites. Coastal Plain loblolly plots have shown better growth, in general, than Piedmont plots.

Sugar maple disease. Previous reports have mentioned a striking mortality of old-growth sugarmaple in the Big Ivy section of the Pisgah National Forest. The blue-stain fungus Endoconidiophora coerulescens was consistently isolated from the wood of dying trees. Inoculations made with this fungus in 1940 in bore holes and chopped-out pockets in the stems and roots have shown typical discoloration and penetration of the fungus as far as 2 feet from the inoculum. Check wounds showed only localized discoloration in 1941. No conclusions have been drawn regarding the part this fungus may be playing in the disease.

In order to determine whether this apparently unusual mortality of sugar maple is materially increasing so as to create a serious problem, a 13-acre plot within the affected area has been established, upon which data on all sugar maples will be taken annually. Further work on the problem will be deferred until the significance of the mortality is better understood.

## Central States

Dayton Elm Disease. As in the last few summers, many elms in Columbus and other infected areas are dying from the disease referred to as the Dayton elm disease or phloem necrosis. Recent contact with work being done to combat this disease indicates additional bad infections at McArthur and at Jackson, Ohio. U. S. Route 40--the National Road--still seems to mark the northern limit of the disease in its known distribution in Ohio.

Coupled with the disease's inroads have been the effects of a persistent drouth extending from July through September. Together, they have greatly increased the loss of yard and street American elms. In Columbus it is estimated that 5,000 of the city's 30,000 elm trees have been killed.

## Northeastern

Dr. L. M. Hutchins, recently placed in charge of the Division of Forest Pathology, spent several days reviewing the work of the New Haven Branch and visited some of the field experiments.

Attention is being given to the prevention of decay in wooden buildings of military cantonments and emergency housing projects. The main problem with buildings without cellars or basements seems to be adequate ventilation beneath the ground floor to prevent the accumulation of high moisture in the air and resultant absorption of water by the surrounding wooden members. Lack of such ventilation results in rapid and destructive development of so-called building rot. Wooden skirtings and other wooden members should not be allowed to come in contact with the soil, and should be kept two or more inches above it.

Shipyards where wooden ships are built and repaired are being visited to learn where and why decay becomes a problem.

A manuscript entitled "Stand Improvement in Northern Hardwoods in Relation to Diseases" is nearly ready for publication. To secure prompt publication it will probably be mimeographed.

### Southern

A manuscript on the fungi associated with the ambrosia beetles of most economic importance in southern hardwood logs and lumber has been prepared for publication. Four new fungus species are described. These fungi apparently are the food fungi of the beetles and cause the restricted stain in the wood around the insect tunnels.

The study on the comparison of Diplodia natalensis from stained wood and similar fungi from cotton, tung, citrus, and pear has been completed and a manuscript is being prepared for publication. Based on morphological and cultural characteristics, wood staining ability, and pathogenicity on tung, cotton, and citrus the isolates showed no differences of specific rating. It is assumed that the small amount of inoculum produced on stained lumber in seasoning yards is augmented by spores produced on cotton and other plants, to produce the large amount of stain caused by D. natalensis during the late summer months.

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